USER MANUAL

ABB

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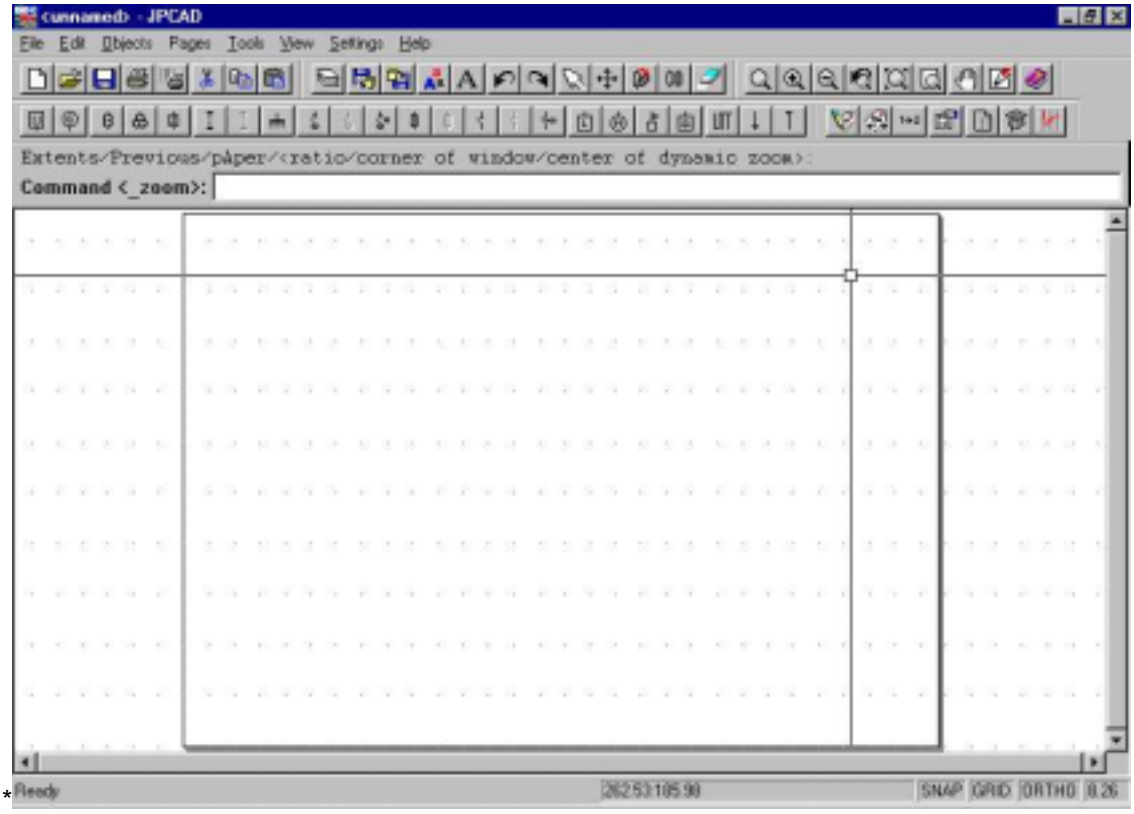
GENERAL APPEARANCE

GENERAL APPEARANCE

The DOCWin workspace consists of the elements shown on the screen, i.e. the *drawing area*, *title bar*, *menu bar*, *tool bar* and *command area*, together with the *scrollbars* and the *status bar*.
The appearance of DOCWin varies according to the screen resolution and the graphics adapter installed in the PC.
The DOCWin workspace is shown below.



COMMANDS AND MENUS

You interact with the program by using commands. A command is an instruction to the program to perform a specific operation. Some commands perform the operation associated with them immediately, while others bring up options or a dialogue box. The operation of any command may be interrupted by pressing *ESC*.

All commands can be initiated by typing the name in the command line, or by selecting the appropriate menu item.

Menus are divided into *drop-down menus* and *toolbar menus with icons,* and contain the following groups of commands:

menu name	*contains commands for*
File	file management
Edit	editing and modifying entities
Objects	inserting electrical symbols
Pages	page layout
Tools	utilities
View	screen management
Settings	defining system data
Help	online help and suggestions

To initiate a command from the drop-down menus

- Point to the name of the menu and left-click.
- A menu item followed by an arrow brings up a nested menu; select the menu item and left-click to access the items it contains.

Frequently-used commands are also available in the form of *icons* (buttons) on toolbars. These toolbars can be freely positioned, either anchored to the edges of the drawing area, or left floating. To initiate a command from an icon, single-click on the icon itself. A description of each DOCWin icon appears when the pointer pauses over them. The *Toolbars* command allows you to choose whether or not to display the toolbar.

TOOLBARS

SETTINGS menu: Toolbars

To display or hide a toolbar

- Initiate the command.
- Click on the check boxes next to the toolbars that you want to display: an **x** in the check box means that that toolbar will be displayed, while if there is no **x**, the toolbar will be hidden.
- Check the *ToolTips* box to display ToolTips when the pointer pauses near an icon. These tips make it easier to understand what icons mean.
- Confirm your selection by pressing **DONE.**

Selected toolbars are located in the position they were in before they were hidden. If a toolbar is being displayed for the first time, it is automatically positioned in the upper part of the work area. All toolbars can be moved, and they can be dragged and anchored to any point of the screen.

To call up a command from an icon

- Click on the button you want.

COMMAND AREA AND COMMAND LINE

The *command area* is the horizontal strip where the dialogue between program and user is displayed. By default, this strip appears in the upper part of the display area, but it can be moved anywhere in the window. It consists of 3 lines, the last of which is called the *command line.*
In the command line, you type the various commands and options for initiating the commands themselves. DOCWin displays the last command used between < > signs, allowing you to confirm it again by pressing ENTER or by right-clicking. Commands can be initiated by typing the capital letter that distinguishes them, typing the whole word or selecting the word with the mouse.

ONLINE HELP AND TOOLTIPS

The HELP command displays the hypertext DOCWin hypertext help file DOCWin.PDF.

HELP menu: Help
Function key F1

A description of each DOCWin icon appears when the pointer pauses over each button, to help you understand the icon menus. These tips can be removed when you are configuring the toolbar.

GENERAL INFORMATION

The command brings up a screen containing information about the product licence.

HELP menu: About

WARNINGS

The command brings up a screen containing information about warnings and instructions

HELP menu: ***Warnings***

COLOURS

This command allows you to change the background colour of the display area and the colour that DOCWin associates to the objects before and after the calculation.

SETTINGS menu: Colours

To change the background colour and the colours of the objects

- Initiate the command.
- When the Windows colour map appears, select one of the standard colours or define a custom colour.
- Press **OK** to confirm.

ADVANCED SETTINGS

This command allows you to set:
- Load-flow parameters (precision, number of iteration, etc.).
- Multiple insertion; this commands allows you to insert again an object after its insertion.
- Numbering object and its step.

SETTINGS menu: Advanced settings

To change the Load-flow parameters and the object insertion method:
Initiate the command.

- When the advanced setting window appears, set the data.
- Press '*OK*' to confirm.

STARTING TO WORK WITH DOCWin

START DOCWin

- Select start button then Programs, ABB TCT, ABB DOCWin
- Double-click on the DOCWin icon.

The workspace appears, i.e. the space used to create a drawing (see GENERAL APPEARANCE).
When COMMAND < _NEW > appears in the command line (see COMMAND LINE AREA), DOCWin is ready.
In most cases, DOCWin asks you for further information in order to carry out a command successfully; a function has always been carried out correctly when COMMAND < _NEW > appears.

To cancel a command

- Press ESC.

To repeat the previous command

- Press ENTER when COMMAND < previous > appears.

To select an option

Left-click on the option to select it, or type the letter shown in capitals and press ENTER, or type the whole word and press ENTER

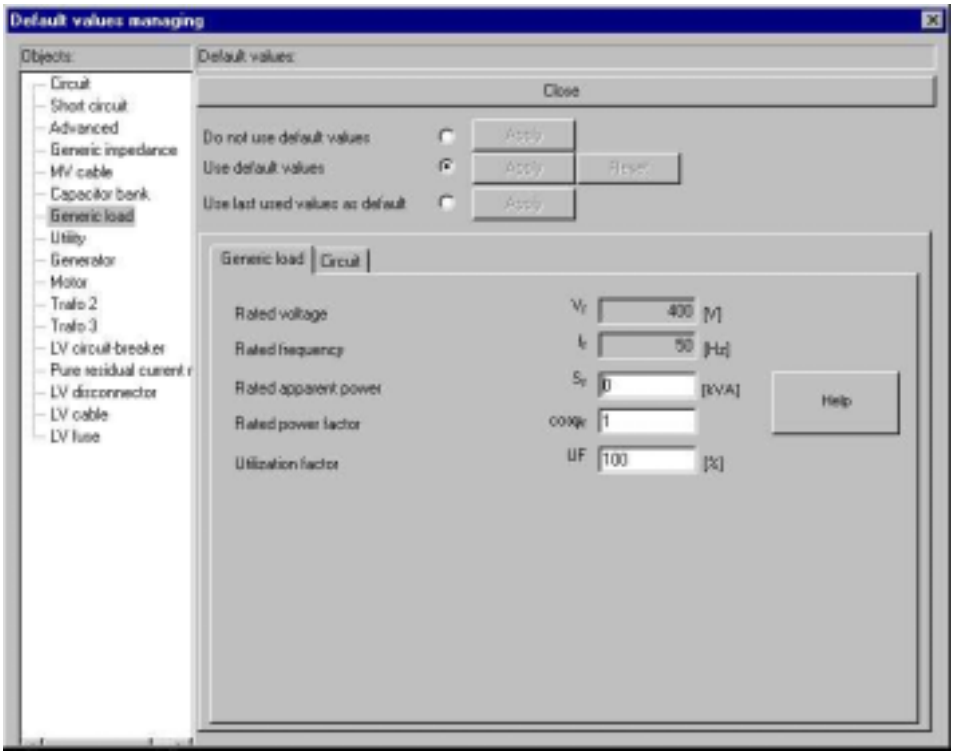
DEFINING A PROTOTYPE

A prototype corresponds to a model to be used to start a new drawing. It contains the default values, such as precision and unit of measure, organisation of layers, text and so on, and parameters relating to objects.
DOCWin allows you to create different prototypes and display them when a new drawing is created.
If there are no customized prototypes, DOCWin opens the generic prototype file PROTOTYP.ILE.

FILE menu: Set prototypes

To create a new prototype

- Start DOCWin.
- Initiate the Set *prototype* command.



The window displayed has three sections:

1. A tree containing a list of objects or project settings.
2. A specific panel containing variables and settings relating to the object selected in the tree Each of these configuration panels is described in detail in the sections relating to those objects or settings.
3. A panel that allows you to select whether or not you want to use the default values::

Do not use default values

The program ignores the values set as default; if this option is selected, specific data must be entered for each object or variable used in the project.

Use default values

The program displays and uses the values set as default.

Use last values set as default

The program displays the last values used.

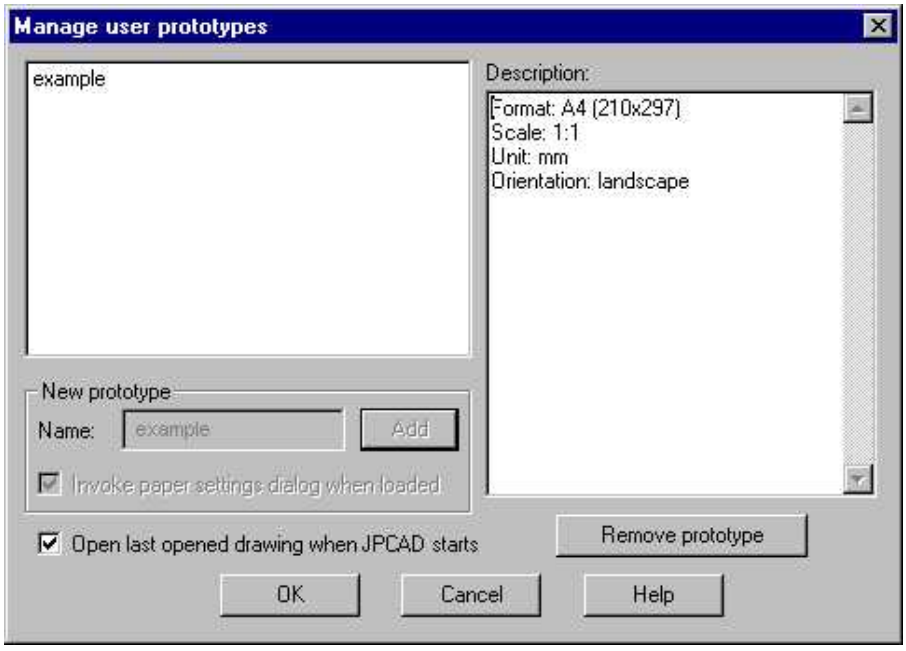
The configuration so obtained can be saved in a specific prototype file.

SAVING A PROTOTYPE

FILE menu: Save prototypes

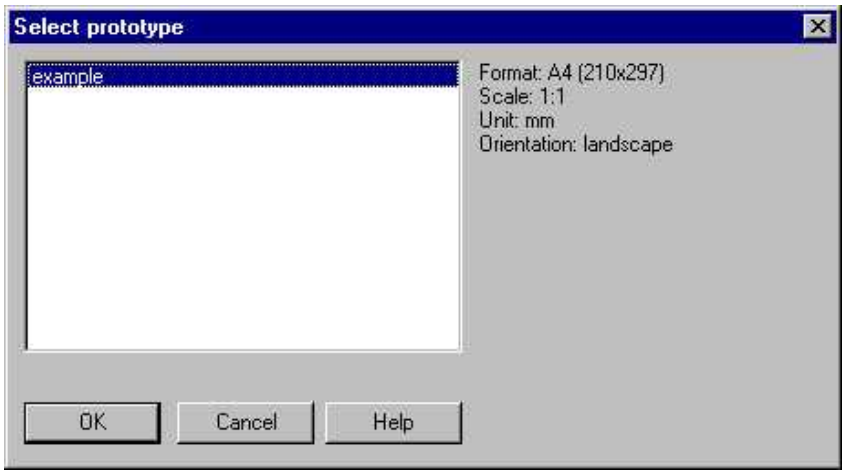
To save a new prototype

- Initiate the command Save prototypes.



- When the dialogue box appears, type the name in the *Name* field
- Check the option *Invoke paper settings dialog when loaded* to bring up the PAGE SETUP command when a file is created.
- Check the option *Open last opened drawing when JPCAD starts* so that DOCWin will automatically open the last file saved.
- Press *Add* to confirm and save the prototype file. The file is immediately included in the alphabetical list in the box above the Name field, and described in the *Description* box; a descriptive text can be added in this box. Close the dialogue box by pressing **OK**.

Each time the NEW command is initiated, DOCWin will display a list of existing prototypes:



STARTING A NEW PROJECT

To start a new project, initiate the command NEW, which allows you to create a new drawing based on a prototype. The drawing is automatically named ANONIMO.ILE. When it is saved for the first time, you can assign a name of your choosing to the file (see SAVE and SAVE AS commands).

FILE menu: New
Function keyCTRL+N

To start a new drawing

- Initiate the command.
- If DOCWin is already running and the current drawing has not yet been saved, a dialogue box appears so you can save it.
- Define the drawing sheet using the appropriate dialogue box and confirm with **OK**.

OPENING AN EXISTING PROJECT

The command OPEN allows you to open existing drawings in *.ILE or *.AMB formats (DOCWin native formats).

FILE menu: Open...
Function keyCTRL+O

To open an existing drawing

- Initiate the command.
- The standard Windows file-opening window is displayed; select the file you want and confirm with **OK**.

EXPORTING

The export commands allow you to save a drawing in a format other than *.ILE.

EXPORTING A DIAGRAM IN AUTOCAD DWG/DXF FORMAT

The DWG and DXF formats are the *de facto* standard in the world of computer-aided design, so you will often find you have to open a *.DWG or *.DXF drawing, and equally often you will have to save a DOCWin drawing in one of those two formats.
When performing these operations, you should take into consideration that:

1. in AutoCAD drawings, **text** is drawn with a font used only by this program; when importing, DOCWin automatically creates a style with the same name as the AutoCAD drawing, but using the system font of your computer, which is typically Arial. This is because the fonts used by AutoCAD do not correspond to Windows TrueType fonts. It is recommended that you reduce this problem by

using the TEXT STYLES command and associating a specific font with each style that appears in the dialogue box. When converting files, DOCWin minimises differences in text size, although the appearance of the text will change (specifically, the font).

2. different **line types** can be defined in AutoCAD drawings; DOCWin will convert these line types into ones which are similar. Unrecognised line types are converted to continuous lines.

FILE menu: Export DWG-DXF

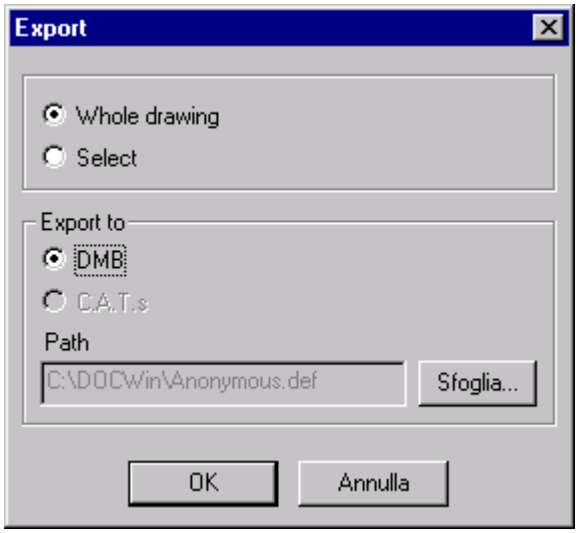
The formats recognised by DOCWin are:

file extension	*description*
DXF	AutoCAD® import-export format
DWG	AutoCAD® native format (version 12, 13, or 14).

EXPORTING A PROJECT IN DMB or CATs FORMAT

This command allows you to select and export a list of DOCWin components in order to read them using DMB 3.0 and C.A.T.s 1.0

FILE menu: Export to C.A.T.s - DMB



The upper area manages elements to be exported: all elements of the project or just those selected (for the latter option, select the objects to be exported)
The lower area allows you to choose the export format and to select the file path for saving the file for DMB, or the project name, for CATs.
NB: in order to export a project to CATs, the CATs program has to be installed.

SAVING A PROJECT

The current drawing can be saved in DOCWin native format (*.ILE) and you can set a default path for saved files. To save in *.DWG and *.DXF formats, use the *Export DWG-DXF* command.. By their nature, these formats save only the appearance of the drawing, rather than all the information contained in a DOCWin drawing, such as layers, line types, supplementary non-graphics data, variables and others.

FILE menu: Save
Function key: CTRL+S

To save the drawing
If the drawing has already been named, DOCWin saves only changes made since the previous version, keeping the same name. However, if the drawing has not been named, the SAVE AS command is displayed (see below).

FILE menu: Save as...

To save the drawing with the name...
The drawing can be saved with another name or in a different format.

- Initiate the command.
- When the standard Windows dialogue comes up, enter the file name. Confirm the change by pressing OK.

To set the path for the directory in which drawings are saved
The program can set the path for the directory in which a drawing is saved, making it possible to enter a customized path which is different from the default path.

- Initiate the SAVE or SAVE AS command.

- When the standard “save” dialogue box appears, select the option *Remember path* which appears in the left lower corner of the window. For all subsequent saves, the Windows window will open in the directory shown.

EXITING DOCWin

Exiting DOCWin means closing the active program session.

FILE menu: Quit
Function keyALT+X

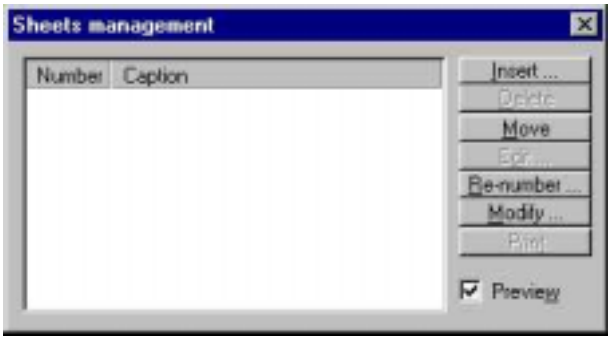
To exit DOCWin

- Initiate the command.
- Confirm whether to save or ignore the last changes made to the drawing before exiting, or cancel the operation of closing DOCWin.

SHEETS MANAGEMENT

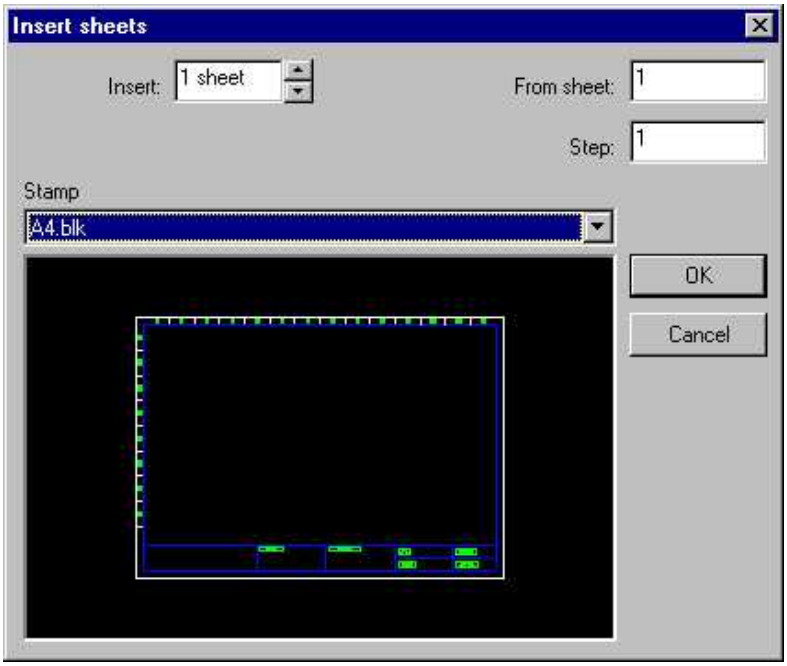
PAGES Menu: SHEETS MANAGEMENT

This command contains all functions relating to the management of pages for the project.



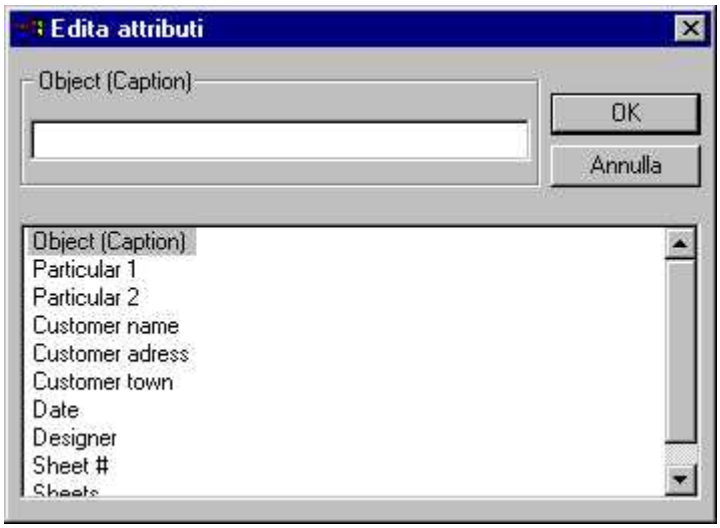
This new interface is used for a number of functions:

- The *Insert* button opens a dialogue box which is used to add pages to the project. The same dialogue box is used for automatic index creation.



In addition to indicating the type of title box to be used and the number of pages to be inserted, you can enter a numbering interval, and the first page number.

- The *Delete* button deletes all pages that have been selected in the pages management dialogue box. You can select several pages at once by holding down SHIFT (for consecutive pages) or CTRL (for individual pages).
- The *Move* button is used to change the order of pages. *Procedure:* select the pages you want to move; press the *Move* button (which will stay down); select the place where you want to insert the pages you have selected, then release the *Move* button to conclude the operation.
- The *Edit* button allows you to compile all the data (Object, Draughtsman, Data, etc.) for the pages selected.



- The *Renumber* button allows you to renumber all the pages, customizing the algorithm used for renumbering.
- The *Modify* button allows you to change the title block in pages that have already been inserted.
- The *Print* button is used to print all the pages selected in the Pages management dialogue box.

SELECTION

Entities in a drawing can be modified only if they have been selected. You can manipulate an entity by selecting it first and then applying the appropriate editing commands, or vice-versa.

SELECTING AN OBJECT: Selection groups

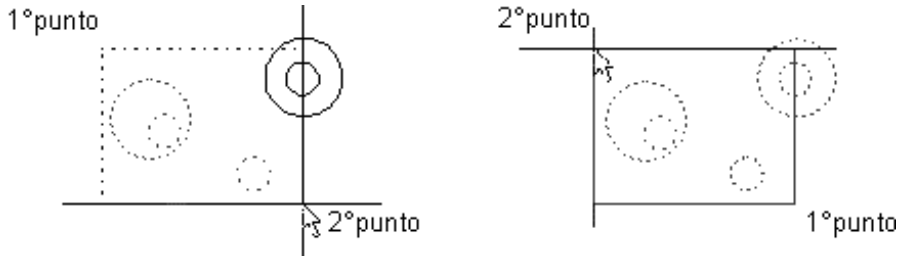
A set of objects is called a *Selection group*. When DOCWin asks for a *Selection group*, the following message is displayed:

- *Select objects:*

Note that the cursor changes from a cross-hair pointer into a selection frame.

There are two different ways in which you can select a set of objects:

- selecting each object with the cursor.
- selecting the option **F** or **WINDOW** to frame the object in a s*election rectangle*, which works in one of two ways, depending on the order in which the two lines defining it are generated:
  1. from left to right (the first point is to the left of the second): only an object which is completely enclosed is selected. The window is displayed as a broken line.
  2. from right to left (the first point is to the right of the second): both objects that are enclosed and objects that are intersected by the borders of the window itself are selected. The window is displayed as a continuous line.



[punto = point]

First type of selection rectangle *Second type of selection rectangle*

Objects contained in the selection group are displayed with a dotted line, while the following message appears in the command line:

- *n entities selected, k duplicates.*
  where *n* stands for the number of objects selected and *k* stands for the number of objects already selected.

Selection continues until concluded by right-clicking, or clicking on the ENTER button.

To display the last selection group saved

- Initiate the desired command.
- When asked to select an object, type **P** or **PREVIOUS** in the command line.
- Continue with the command initiated.

To remove an object from a selection group

The option **R** allows you to deselect an object from a **selection group**.

- Initiate the desired command.
- When you are asked to select an object, type **P** or **PREVIOUS** in the command line.
- Type **R** or **REMOVE** in the command line.
- Specify the objects to be removed from the selection group. From this time it is possible only to remove objects from the selection group. If you need to add other objects, see the option **A** or **ADD** described below.
- Continue with the current command.

To add an object to a selection group

The command option **A** allows you to add an object to a selection group. The default option is Add, so it should be selected only if the option **R** has previously been used.

- Initiate the desired command.
- When you are asked to select an object, type **P** or P**REVIOUS** in the command line.
- Specify the object to be added to the selection group.
- Continue with the command initiated.

or

- Initiate the desired command.
- When you are asked to select an object, type **P** or **PREVIOUS** in the command line.
- Type **R** or REMOVE in the command line.
- Specify the object to be removed from the selection group.
- Type **A** or **ADD** in the command line.
- Specify the object to be added to the selection group.
- Continue with the command initiated.

Selecting an object before activating a command
A selection group can also be created without initiating a command using one of the two methods described above. If you initiate a command that asks you to enter an object to be selected, i.e.

- *[Select object:*

the selection group is automatically entered. You can therefore work in either the order COMMAND->OBJECT, or OBJECT->COMMAND.

Example
If you want to transfer part of the drawing onto the Clipboard so that it can subsequently be copied into another document: with DOCWin in Ready
mode, define a point in the top right part of the drawing to be copied, followed by a second point at bottom left. The entities enclosed will be identified.

Select the icon . The entities selected are now available on the Clipboard.

For consistency, when describing subsequent commands, we will describe selection of entities only within a command.

SELECT

This command is used to save a selection group.
The selection group shown can therefore be brought up during the selection stage of a command, by responding **P** or **PREVIOUS** at the prompt to select the entities.

Command SELECT

To create a selection group

- Initiate the command.
- Select the entities to be included in a **selection group,** using the methods described in the appropriate paragraph.
- Confirm the selection with ENTER.

See also: selection groups.

EDIT

CUT, COPY, PASTE, in this and other applications

You can copy entities within drawings belonging to several DOCWin sessions, or in other applications. The selected entities are saved on the Windows Clipboard.

To cut

EDIT menu: Cut
Function keyCTRL+X

The CUT command allows you to cut one or more entity to be pasted one or more times into another DOCWin session or another application, while deleting it completely from the source application.

To copy

EDIT menu: Copy
Function keyCTRL+C

The COPY command allows you to copy one or more entity to be pasted one or more times into another DOCWin session or another application.

To paste

EDIT menu: Paste
Function keyCTRL+V

The PASTE command allows you to paste one or more previously copied entities using the COPY and CUT commands one or more times into another DOCWin session or another application.

DUPLICATE

The DUPLICATE command allows you to copy one or more entity one or more times within the current drawing.

EDIT menu: Duplicate

To duplicate an entity one or more times

- Initiate the command.
- Select one or more entities that are to be duplicated within the drawing and press ENTER to stop the selection process and continue with the command.
- Determine the reference point of the entity to be duplicated by specifying a point.
- Specify the point at which the new duplicated entity will be positioned, by left-clicking.
- To duplicate the same object at other points in the project, specify each of the points at which the new duplicated entities are to be positioned, by left-clicking.
- Press ESC or right-click to terminate the command.

MOVE

The command allows you to move one or more entities from one position to another.

EDIT menu: Move

To move an entity

- Initiate the command.
- Select one or more entities to be moved within the drawing and press ENTER to terminate selection and continue with the command.

- Specify the reference point for the whole selection.
- Specify the new position.

ROTATE

This command allows you to rotate one or more entities by changing its position from vertical to horizontal and vice-versa.

EDIT menu: Rotate

To rotate an entity

This is the default method for rotating an entity.

- Initiate the command.
- Select the entity to be rotated.
- Press ENTER

ERASE

This command allows you to erase the selected entity.

EDIT menu: Erase

To erase an entity

- Initiate the command.
- Select one or more entities that are to be erased within the drawing.
- Press ENTER to confirm the selection.

UNDO STEP

DOCWin allows you to go back through completed steps while editing a drawing. The same method allows you to restore something you have deleted, without limitation.

EDIT menu: Undo step
Function keyCTRL+Z

To cancel the last command

The command A undoes the last single action.

- Initiate the command.
- Repeat the command as many times as there are operations that you want to undo.

REDO STEP

You can restore the last command cancelled or a number of commands cancelled previously, until you return to the original situation.

EDIT menu: Redo Step
Function keyCTRL+Y

To restore the last command that was undone

- Initiate the command.
- Repeat the command as many times as the operations you want to redo.

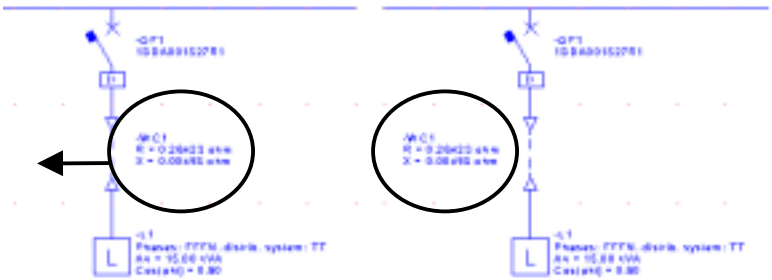
MOVE OBJECT DATA

The MOVE OBJECT DATA command allows you to move the data belonging to an object.

EDIT menu: Move object data

To move object data

- Initiate the command.
- Click on the object containing the data you want to move; the data will become attached to the mouse pointer.
- Drag the data into the new position and click to anchor.



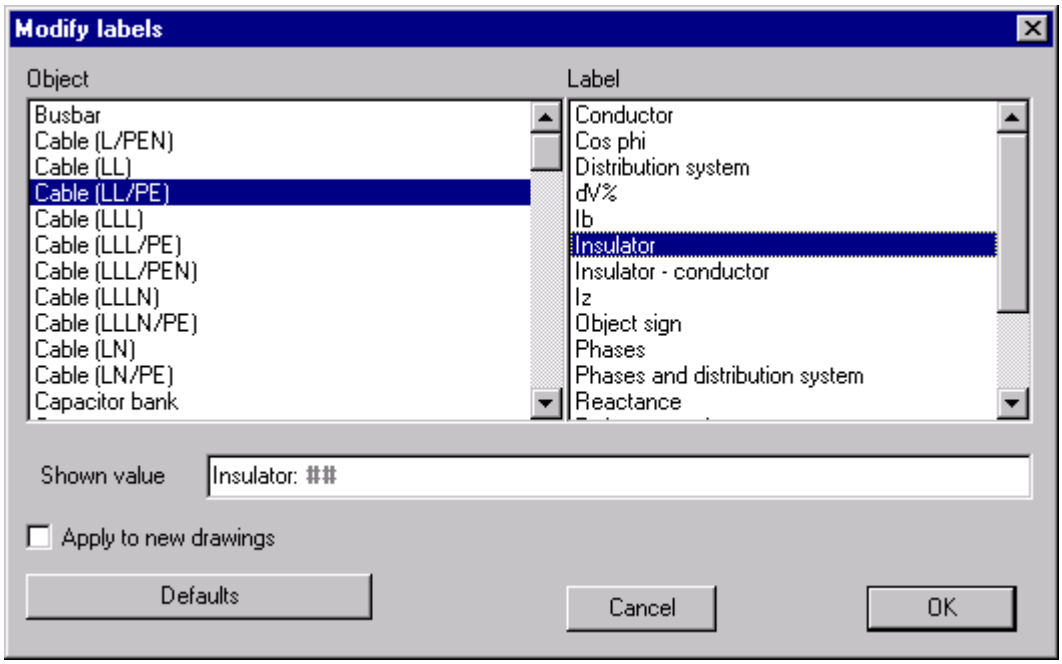
EDIT OBJECT DATA

The EDIT OBJECT DATA command allows you to change the contents of the object labels.

EDIT menu: Edit object data

To modify object data

- Initiate the command.
- Click on the object whose labels you want to modify.
- Modify the contents of the labels in the “shown value” box.



RENUMBERING

The RENUMBERING command allows you to number objects automatically in order, “top to bottom” and “left to right”.

EDIT menu: Renumbering

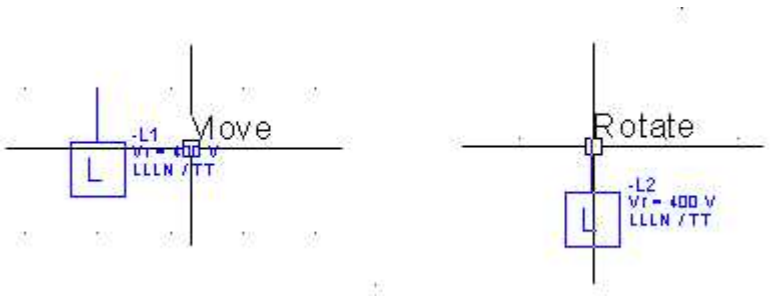
To renumber objects

- Initiate the command.

SMART MODIFY

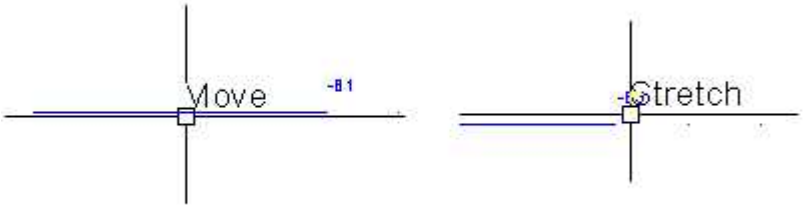
EDITmenu: Smart Modify

The *SMART MODIFY* command allows you to move or rotate one or more objects at a time, and from time to time suggests the most appropriate action.
The name of the command just chosen by the function is constantly displayed above the mouse pointer based on the position of the mouse with respect to the object.
If the pointer is sufficiently close to the symbol insertion point, the SMART MODIFY command suggests applying ROTATE to the object; however, if the point is either on the object, but not near the insertion point, it suggests applying MOVE.
When a number of objects are selected at the same time, only the command MOVE will be applied.



[Sposta = Move; Ruota = Rotate]

In the specific case of BUSBAR, the command suggests STRETCH when the pointer is near the end of the busbar and MOVE when the pointer is near the busbar, but not near either end.
In the illustration, you can use the command STRETCH to increase or reduce the length of the busbar.



[Stira = Stretch]

VIEW

ZOOM / IN / OUT

The ZOOM command allows you to zoom in (enlarge) and zoom out (reduce) on the display in the drawing area. DOCWin allows you to set various types of zoom, by defining a window containing a detail of the drawing, by displaying the whole drawing or by setting an enlargement or reduction scale.
VIEW menu: Zoom, Zoom in (CTRL++), Zoom out (CTRL+-)

To zoom in or out on the display by using a scale factor

- Initiate the command.
- Specify the ratio by which to zoom in or out, by typing a scale factor in the command line. Scale values greater than 1 will enlarge the view, scale values less than 1 will reduce the view, while negative scale values mirror the content with respect to the X=Y axis.
  For example, if you set the value:

  2 the drawing is enlarged to twice its size (also see the icon);
  0.5 the drawing is reduced to half its size (see also the icon);
  1 the display view remains unchanged;

-1 the display view remains unchanged and the drawing is mirrored;
-2 the drawing is mirrored and enlarged to twice its size;
-0.5 the drawing is mirrored and reduced to half its size.

To zoom in or out on a detail of the drawing using a window

The contents of a rectangular window are extended to the whole screen.

- Initiate the command.
- Set the first corner of a rectangular frame containing the drawing detail which is to be scaled up or down.
- Set the second corner of the rectangular frame, opposite the first.

To zoom in or out on a drawing using dynamic zoom

You can zoom in or out on a whole drawing from a reference point depending on how the cursor is dragged.

- Initiate the command.
- Click close to the dynamic zoom reference point.
- Choose the option **D** or **DYNAMIC** in the command line.
- Drag the mouse: the detail can be seen to zoom in and out.
- Click near the details you want.

To extend the drawing to the whole screen

Allows you to reproduce a larger view of the whole entity drawn.

- Initiate the command.
- Type **E** or **EXTEND** in the command line.

To extend the drawing to the whole drawing sheet

Reproduce the display on the whole drawing sheet.

- Initiate the command.
- Type **A** or **PAGE** in the command line.

To return to the previous display

You can display the last screen viewed. It is understood that it is the display view that is restored and not the previous content of a drawing that has been modified, and that the previous display view can only be restored one time, once the zoom command has been activated.

- Initiate the command.
- Type **P** or **PREVIOUS** in the command line.

PAN

.

The DPAN command allows you to move the current display view of the drawing in any direction in the screen, keeping it the same size; the operation is dynamic.

View menu: Pan

To move the current display view

- Initiate the command.
- Specify the reference point for the move.
- Specify the second point to determine the distance, position and direction of the move with respect to the reference point.

REDRAW

The command refreshes the drawing, clearing the screen, updating entities and displaying any hidden changes to entities.

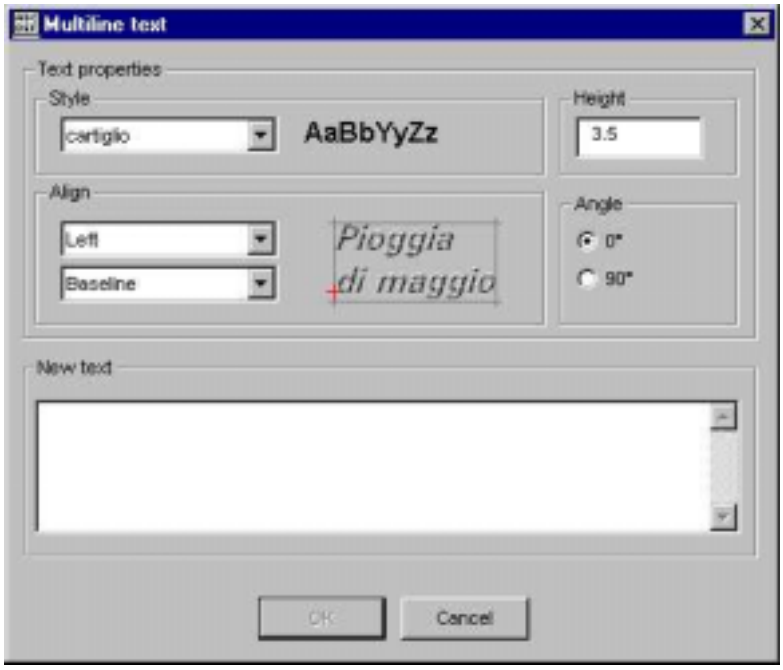
VIEW menu: Redraw
Function keyF5

TEXT MANAGEMENT

TEXT

Menu: ***TOOLS***

The TEXT command allows you to create a complete phrase several lines long by using a single command. The parameters that can be set in this dialogue box are shown below.



The *Style* combo box allows you to list the last text styles created using the DOCWin TEXTSTYLE command.

MODIFY or EDIT TEXT

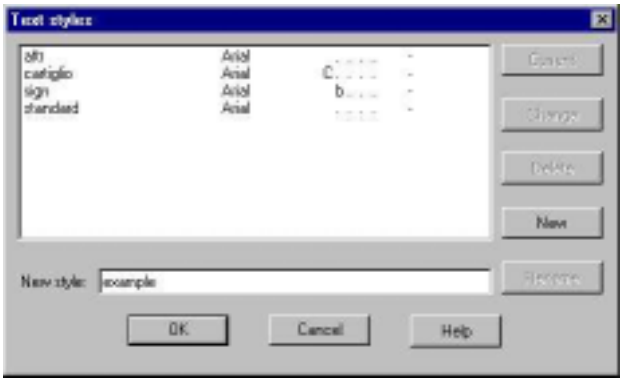
Command: ***PROPERTIES***
Menu: ***EDIT]***

Allows you to modify the properties or content of multi-line text which has already been entered on the schematic. Once the text to be modified has been selected, a dialogue box opens which is similar to the box used to create the actual text, the only difference being that text height and angle of rotation cannot be changed.

TEXT STYLE

With DOCWin you can define custom text styles and give them a name. Text styles include text properties such as font (supported by the Windows system fonts; may also be a TrueType font), height (fixed, or changed from time to time), and appearance (bold, italic, strikeout, underlined). TEXTSTYLE is used to bring up the dialogue box to define or modify the text style.
The *default* style is created by DOCWin when text is entered and no style has been defined. It should be remembered that when the properties of a style are changed, the new modifications will be applied to all texts written in that style.

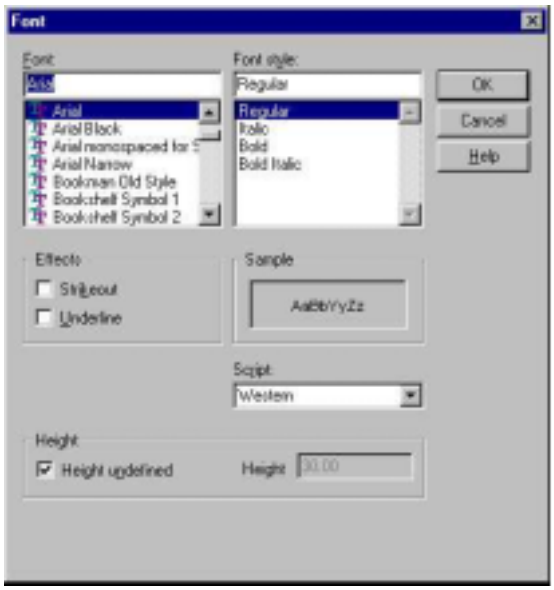
Command: _TEXTSTYLE
TOOLS menu: Text style



<u>Important</u>: text styles are saved in the current drawing; before you can access them in a new drawing, they have to be saved in a prototype (see PROTOTYPE).

To create a new text style

- Initiate the command.
- When the dialogue box appears, type the name of the style to be created in the *New style* box.
- Confirm with *New*.
- Specify the font and style, set fixed height if desired, and check the style that will be shown in the sample box.



- Confirm with **OK**.

To modify an existing text style

- Initiate the command.
- When the dialogue box appears, click on the text style to be modified and confirm with *Change*.
- Modify the style settings.
- Confirm with **OK**.

To modify a current text style

- Initiate the command.
- When the dialogue box appears, click on the text style to be modified and confirm with *Change*.
- Modify the style settings.
- Confirm with **OK**.

The modified settings will be applied to all text entered using this current style.

To delete a text style

- Initiate the command.
- When the dialogue box appears, click on the text style to be deleted and press *Delete*.
- Confirm with **OK**.

To make another text style the current style

- Initiate the command.
- When the dialogue box appears, click on the name of the style which is to be made the current style and press *Current*.
- Confirm with **OK**.

All text that is entered will use the text style which has just been made the current style.

To rename a text style

The name of a text style can be changed without changing its properties.

- Initiate the command.
- When the dialogue box appears, click on the name of the style to be renamed.
- Type in the *New* field the name to be given to the selected style, and press *Rename*.
- Confirm with **OK**.

MACROS

Save a MACRO

This command allows you to save a ***macro*** in a file, i.e. parts of a schematic that can be reused a number of times within the same project or in subsequent projects.

- Start the EXPORT MACRO command.
- Select all the objects that you want to include in the MACRO.
- Press ENTER to confirm the selection.
- Select the insertion point for this MACRO (this is the point where the mouse pointer will be when the MACRO is inserted).
- In the Windows screen, insert the name of the file to be saved.
- Close the command by pressing <Save>.

Insert a MACRO

This command allows you to bring up a previously saved MACRO and insert it into the schematic.

- Initiate the IMPORT MACRO command.
- In the Windows screen, select the name of the file to be imported.
- Select the MACRO insertion point with the mouse.

OBJECTS

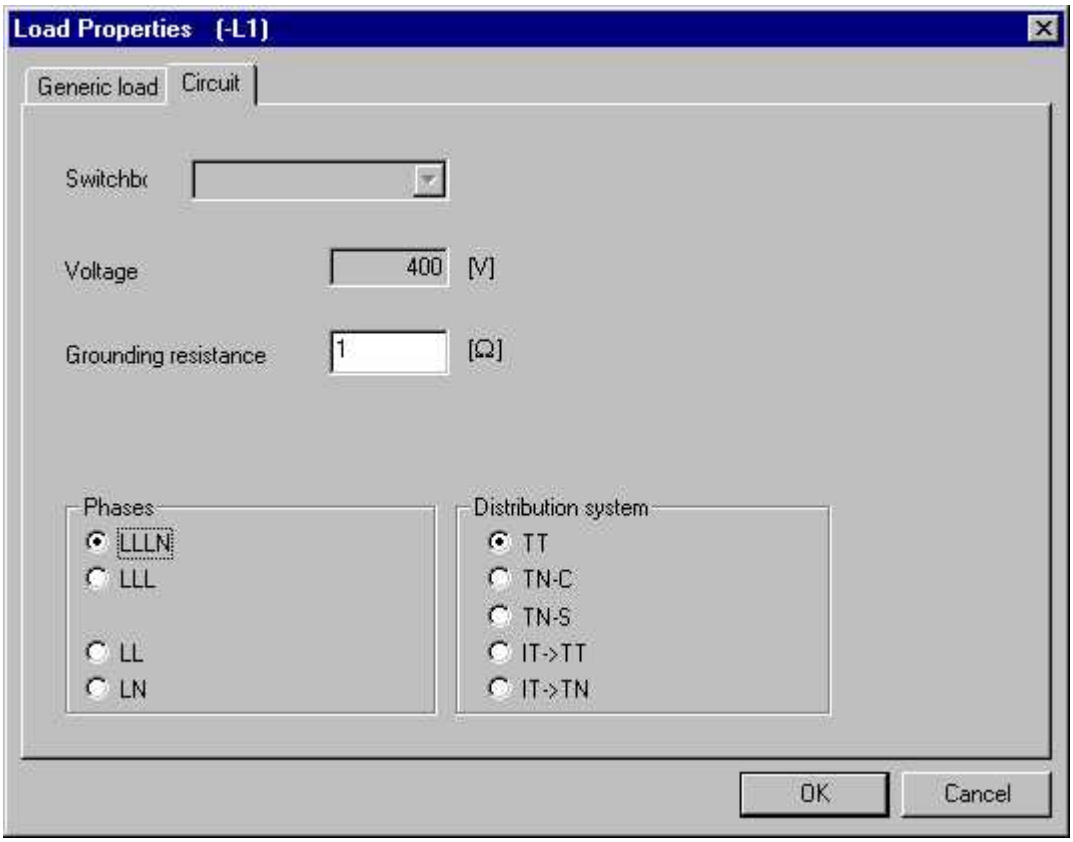
To draw a one-line diagram of the network to be studied, DOCWin has a library of objects contained in the 'Objects' toolbar

Objects in red refer to medium voltage and are available in the 'Plant general properties' dialogue box only if it has been decided to included a medium voltage level.

Object properties are grouped in panels which are accessed via the PROPERTIES command.

The number of phases of the object or distribution system can be changed in the circuit panel.

If required, you can define a name for the switchboard on which the object is located, and the grounding resistance of the object.

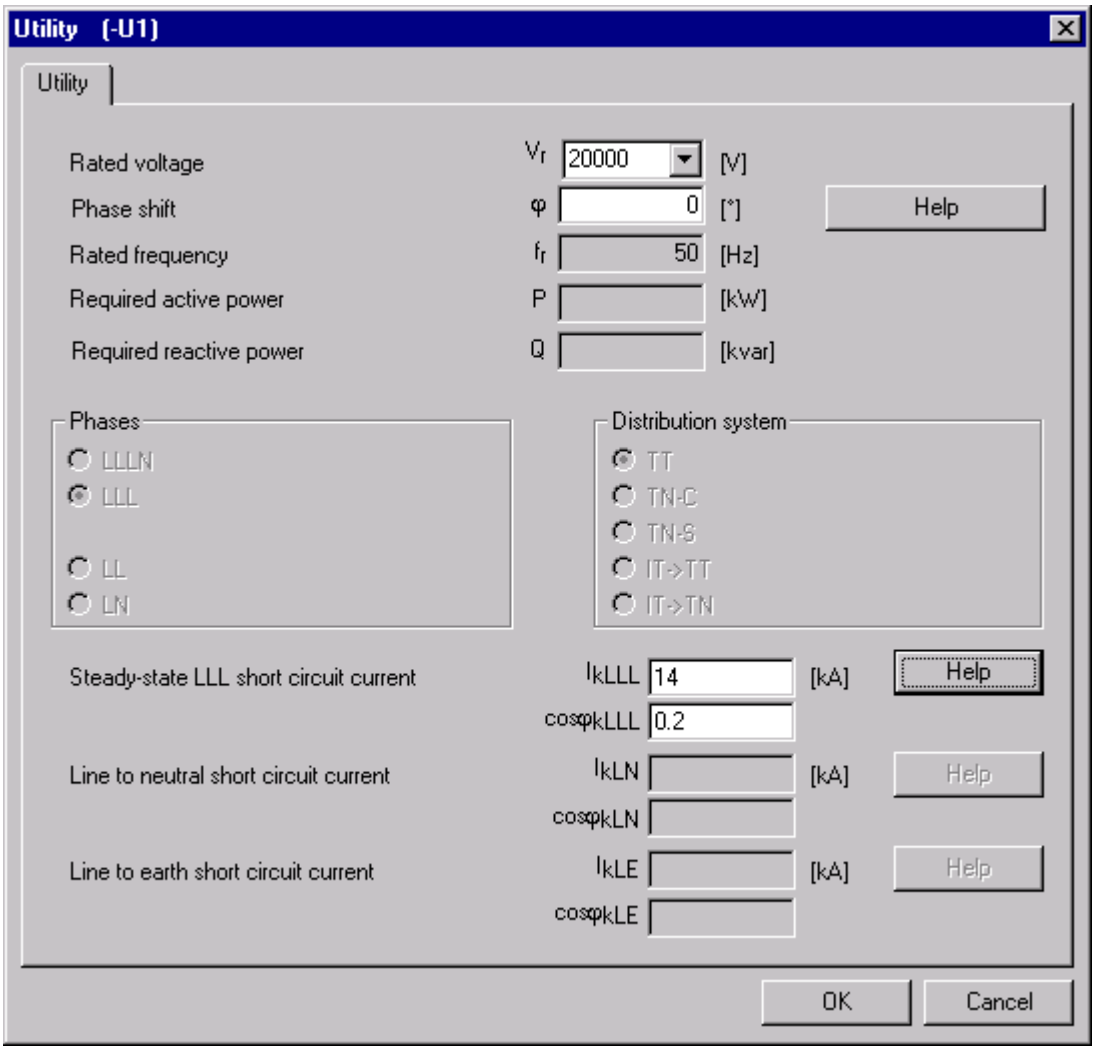


With regard to the distribution system and number of phases, remember:

- when an object is drawn without being attached to another object, you will be able to define the distribution system and number of phases;
- if an object is drawn attached to another object already present in the one-line diagram, it will inherit the distribution system and number of phases of the object already drawn.

A brief description of objects and their interfaces is given below.

UTILITY

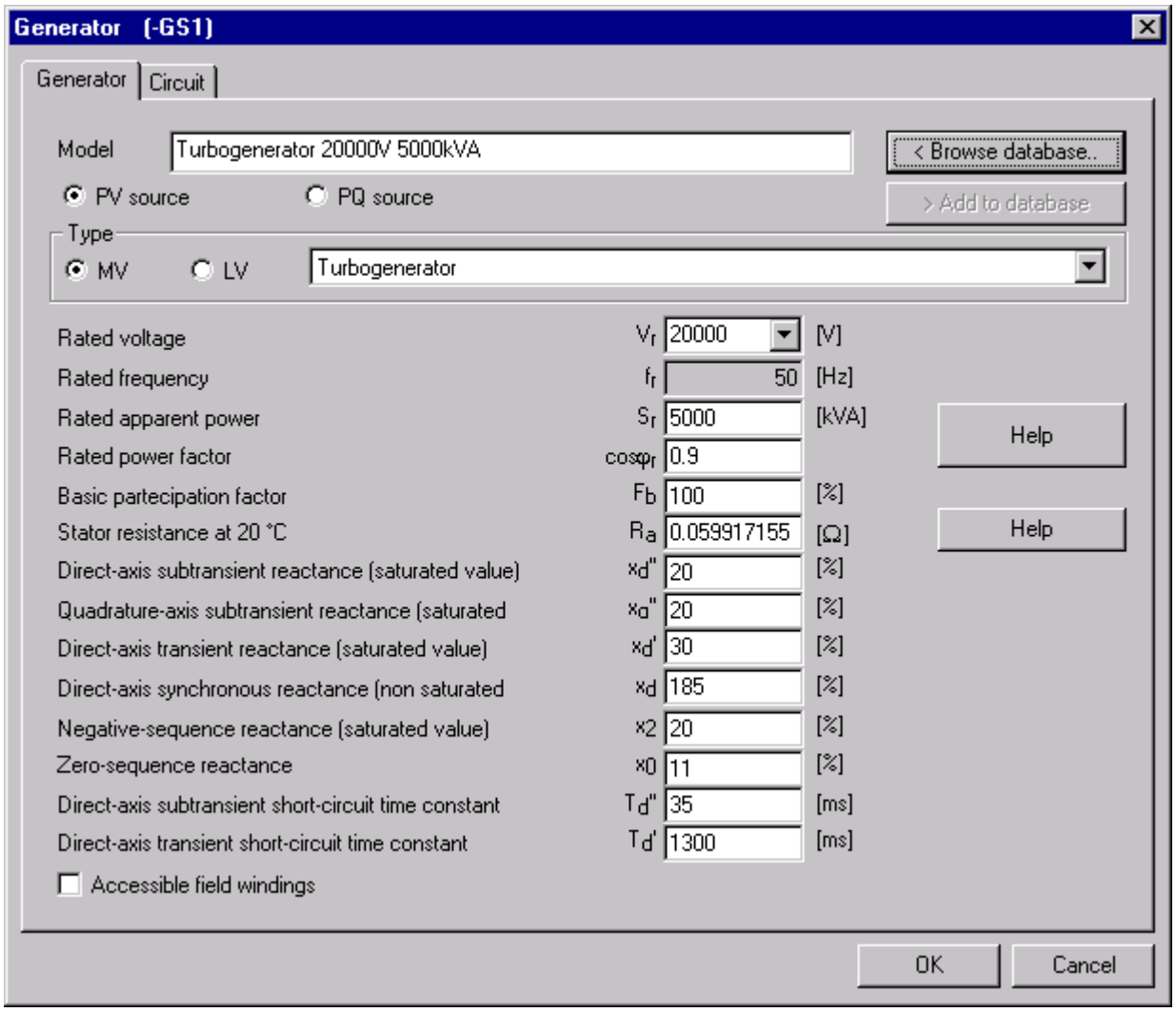


The utility interface inherits the variables set in the 'Plant general properties' dialogue box and allows you to modify the rated utility voltage, the distribution system and the number of phases.

If the utility is medium voltage, the distribution system and number of phases do not have to be defined; in fact, DOCWin only handles an IT distribution system with no neutral.

You also need to insert data concerning the network contribution to the short-circuit current. If data on short-circuit current are not available you can access the *I_k calculation* interface via the '*Help*' button next to the box where the data is entered, and enter data about short-circuit impedance or short-circuit power.

GENERATOR



The panel is used to enter machine parameters which are used to calculate load-flow and short circuit.

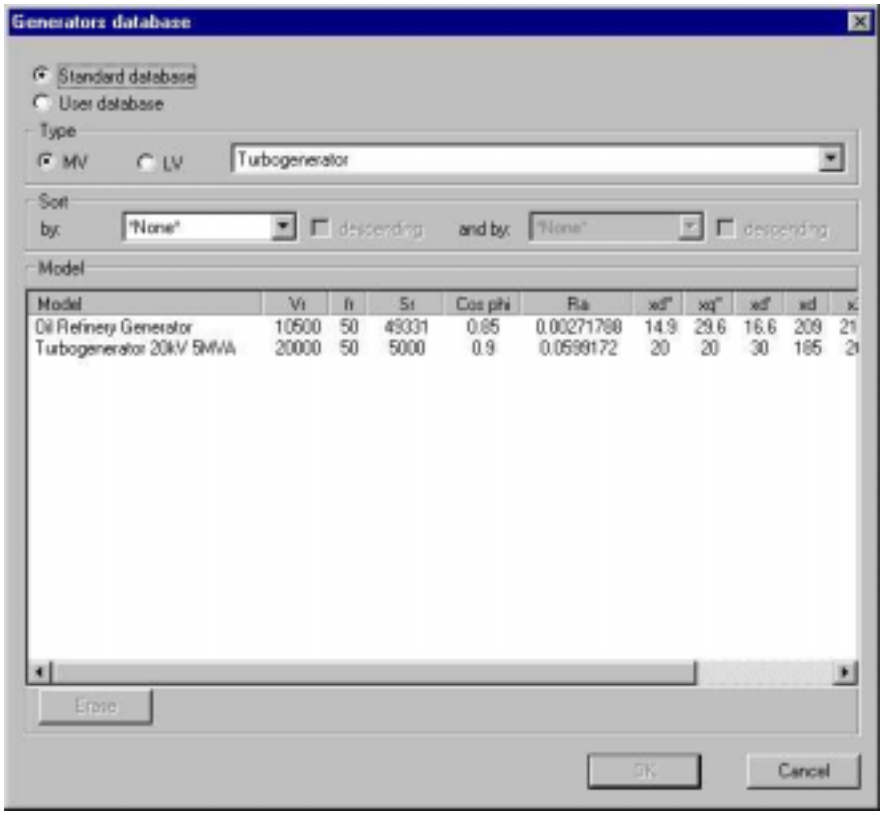
Data relating to machine power can also be entered by pressing the '*Help*' button next to the data.

Data relating to stator resistance can be entered once you know the continuous DC time constant, which you can find by pressing the appropriate '*Help*' button.

A critical factor in obtaining a correct load-flow calculation is choosing whether the generator will run with constant active and reactive power (*PQ Source* option) or constant voltage and active power (*PV Source* option).

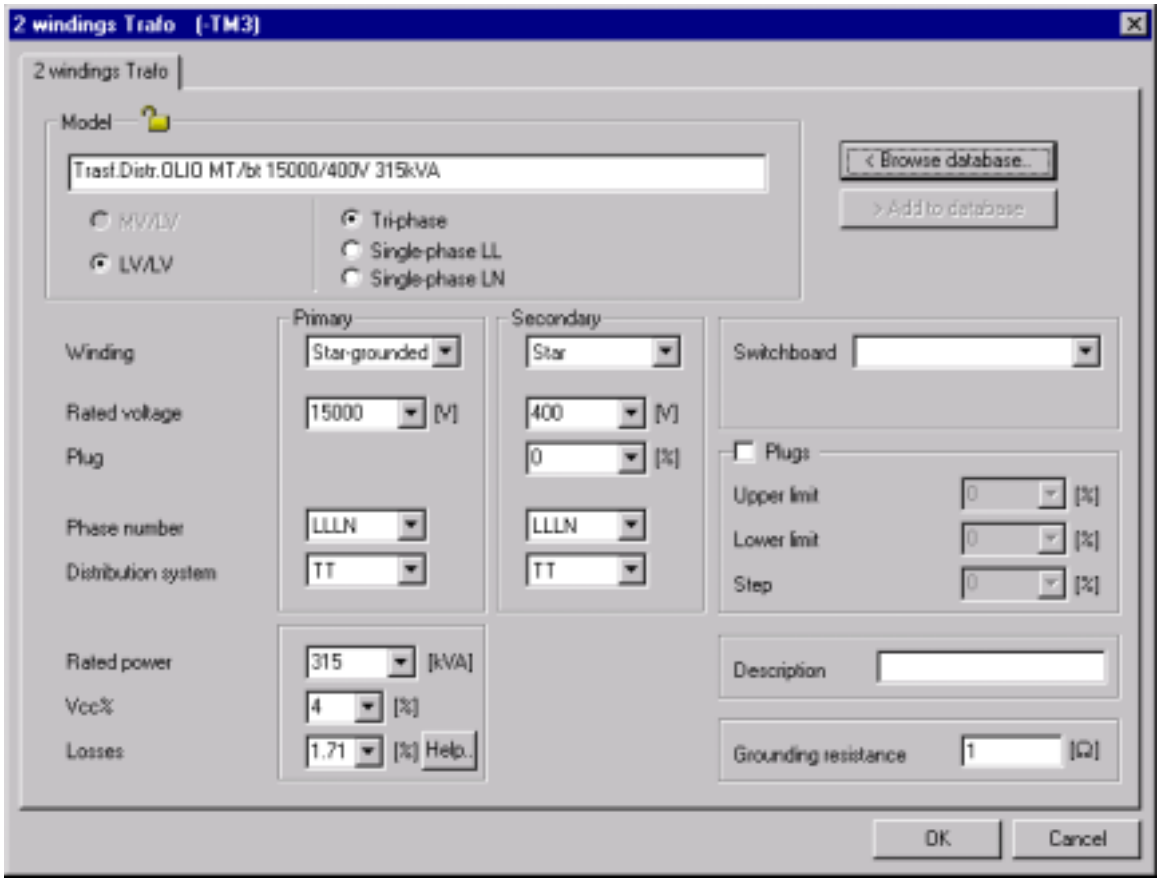
The Browse Database command allows you to select generator data from a standard database or from a user database.

To make it easier to identify the generator you want, the database displays alternative low- and high-voltage machines, allows you to choose the type of generator and allows you to sort the list of generators by two user-selected criteria.



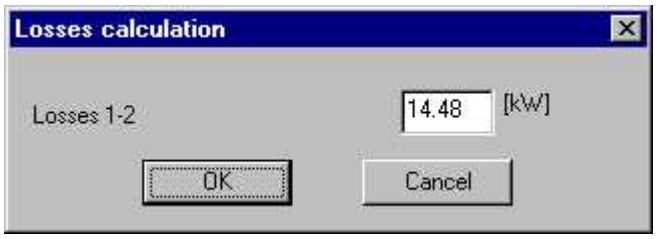
A generator can be added to the user database simply by entering the data, assigning a name in the *Model* box and pressing the *Save to database* button.

TWO WINDINGS TRANSFORMER



The panel is used to manage primary and secondary windings. In particular, you are completely free to choose a secondary distribution system for starting a new section of the network.
DOCWin has no limitations in management of distribution systems.
When the calculations have been done, the program checks that the type of winding, distribution system and number of phases are compatible with the calculated power flow.

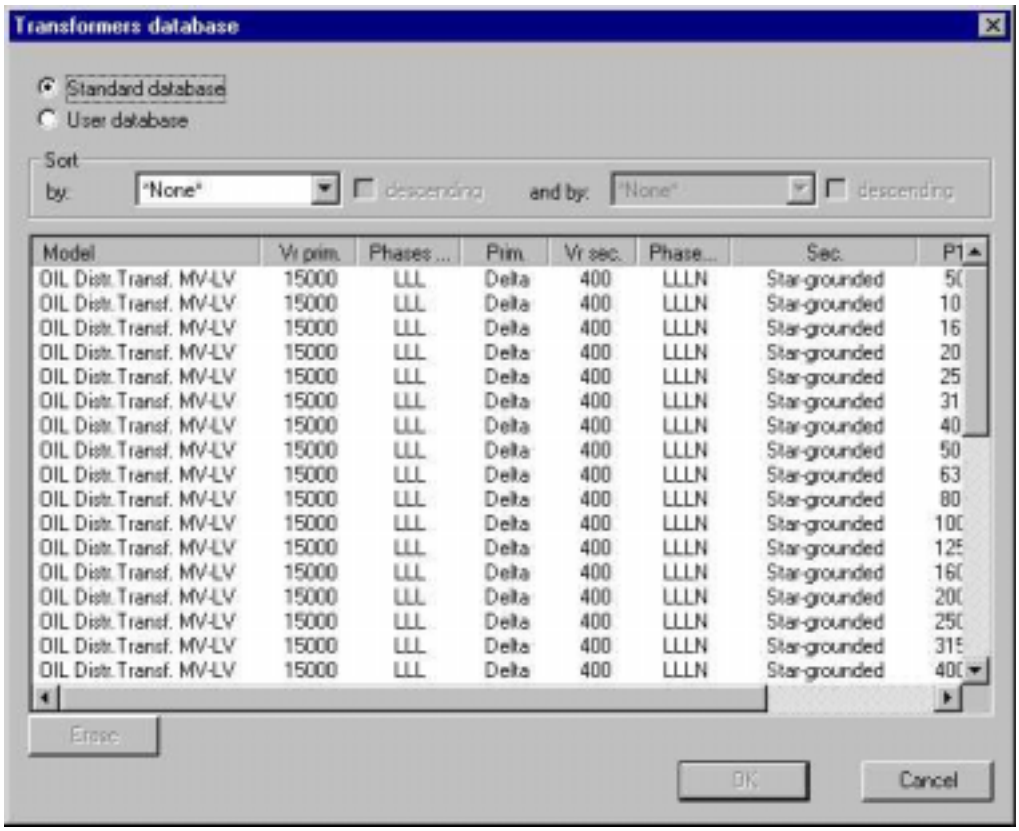
DOCWin automatically calculates the rated power of the transformer in order to supply the loads.
It is possible to set the transformer rated power, short circuit voltage and losses. The drop-down boxes already contain appropriate data values, which can be modified. In this case we have to lock this choice by pressing the padlock icon. This locking prevents the values that have been set from automatic modification by the program during automatic network calculation procedures.
Data relating to short circuit losses can be entered in kW by pressing '*Help*'.



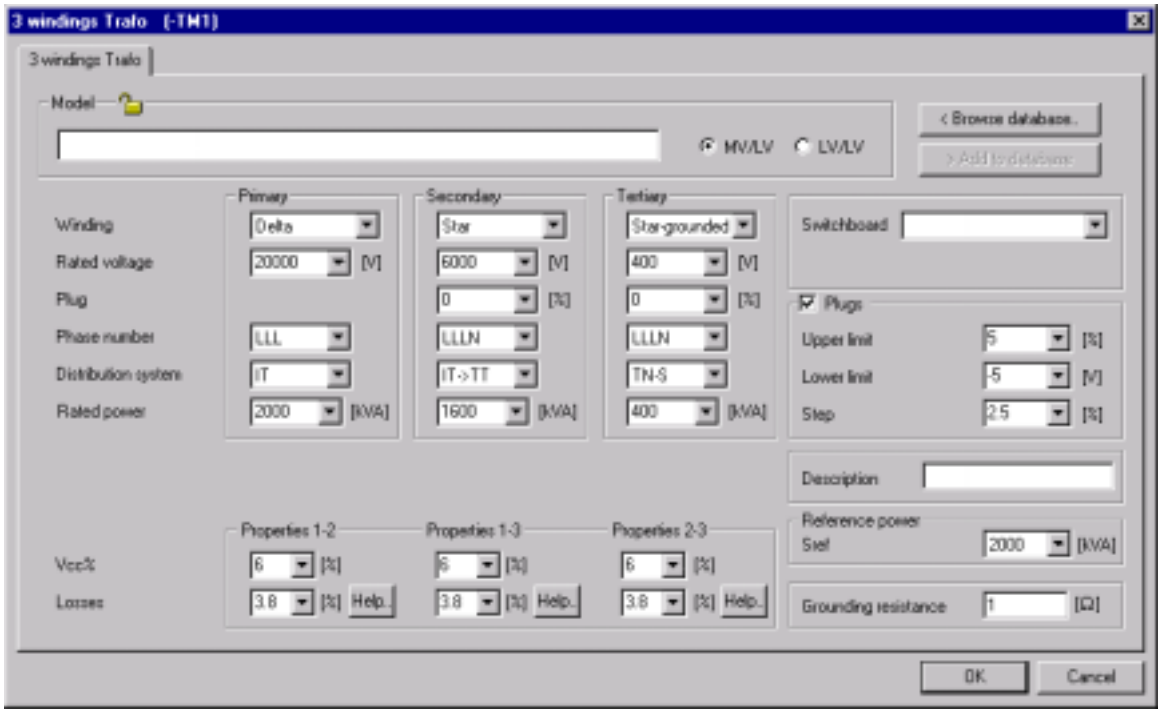
The interface manages the transformer plugs in order to have an appropriate voltage level on the secondary side. In this case you have to select the '*Plugs*' check box and insert:
- the upper limit in per cent of the rated voltage;
- the lower limit in per cent of the rated voltage;
- the step in per cent of the rated voltage;

After that in the drop-down box '*Plug*' you can set the plug position.
In this case we have to lock this choice by pressing the padlock icon. This locking prevents the values that have been set from automatic modification by the program during automatic network calculation procedures.

A database of standard transformers and a user database have been provided, for greater convenience.
The standard database can be sorted by two user-defined criteria to make it easier to choose the right transformer.



THREE WINDINGS TRANSFORMER



The panel is used to manage primary, secondary and tertiary windings. In particular, you are completely free to choose a secondary and tertiary distribution system for starting a new section of the network.
DOCWin has no limitations in management of distribution systems.
When the calculations have been done, the program checks that the type of winding, distribution system and number of phases are compatible with the calculated power flow.

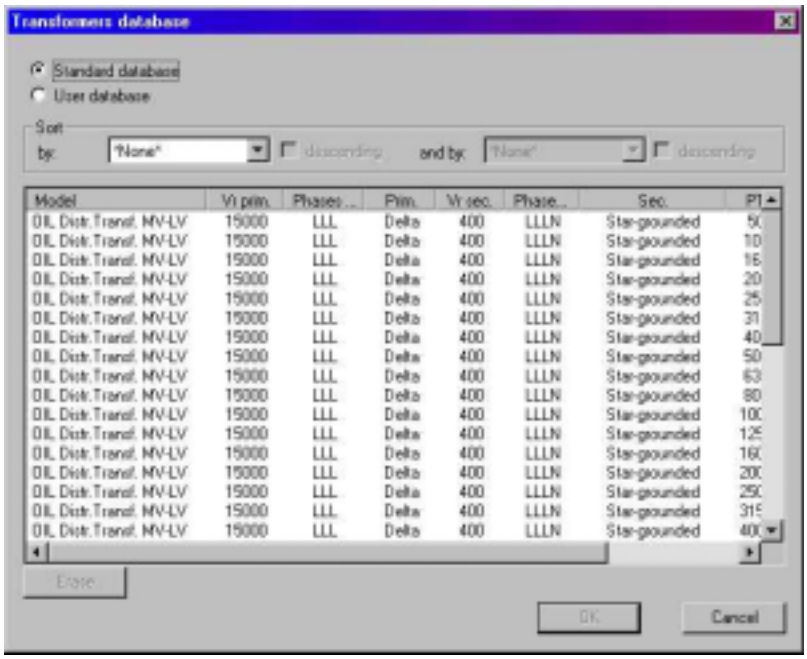
DOCWin automatically calculates the rated power of the transformer in order to supply the loads.
It is possible to set the transformer rated power, short circuit voltage and losses. The drop-down boxes already contain appropriate data values, which can be modified. In this case we have to lock this choice by pressing the appropriate padlock icon. This locking prevents the values that have been set from automatic modification by the program during automatic network calculation procedures.

Data relating to short circuit losses can be entered in kW by pressing '*Help*'.

The interface manages the transformer plugs in order to have an appropriate voltage level on the secondary side. In this case you have to select the '*Plugs*' check box and insert:
- the upper limit in per cent of the rated voltage;
- the lower limit in per cent of the rated voltage;
- the step in per cent of the rated voltage;

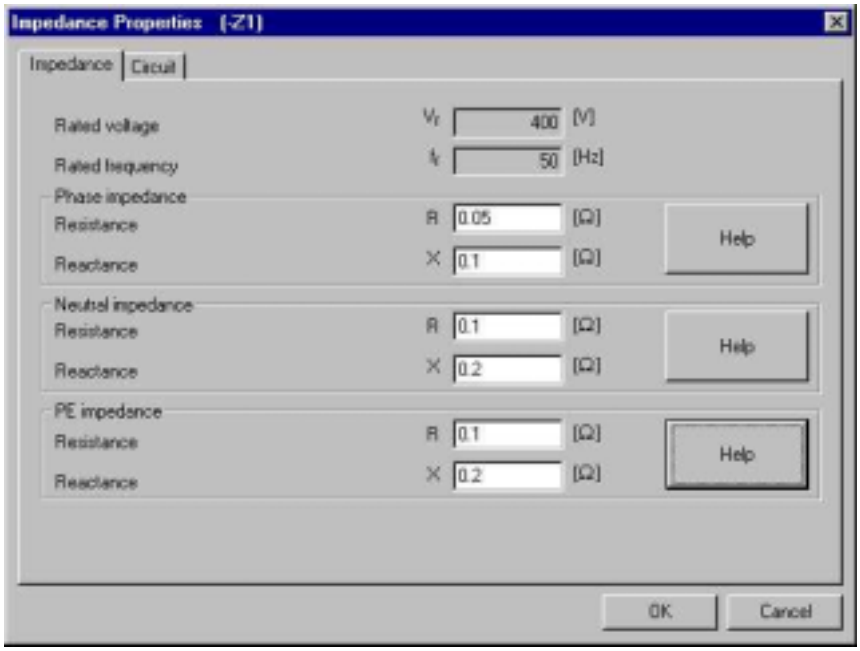
After that in the drop-down box '*Plug*' you can set the plug position.
In this case we have to lock this choice by pressing the padlock icon. This locking prevents the values that have been set from automatic modification by the program during automatic network calculation procedures.

To calculate impedance values, define the reference power in the Reference power combo box.
A database of standard transformers and a user database have been provided, for greater convenience.
The standard database can be sorted by two user-defined criteria to make it easier to choose the right transformer.

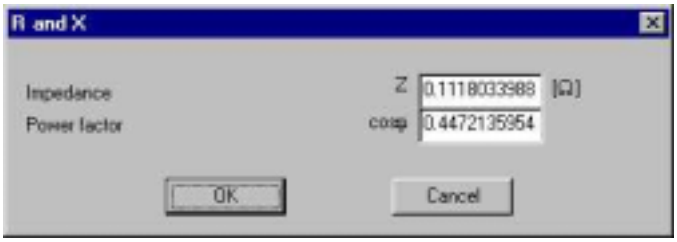


GENERIC IMPEDANCE

Generic impedance is an object which can be entered in the network to model a real entity which has impedance and which is not present in the DOCWin list of objects.
The object interface allows you to enter the resistance and reactance of conductors which are present in the object compatible with the distribution system and number of phases which appear in the '*Circuit*' panel.



Data can also be entered by pressing the '*Help*' button.



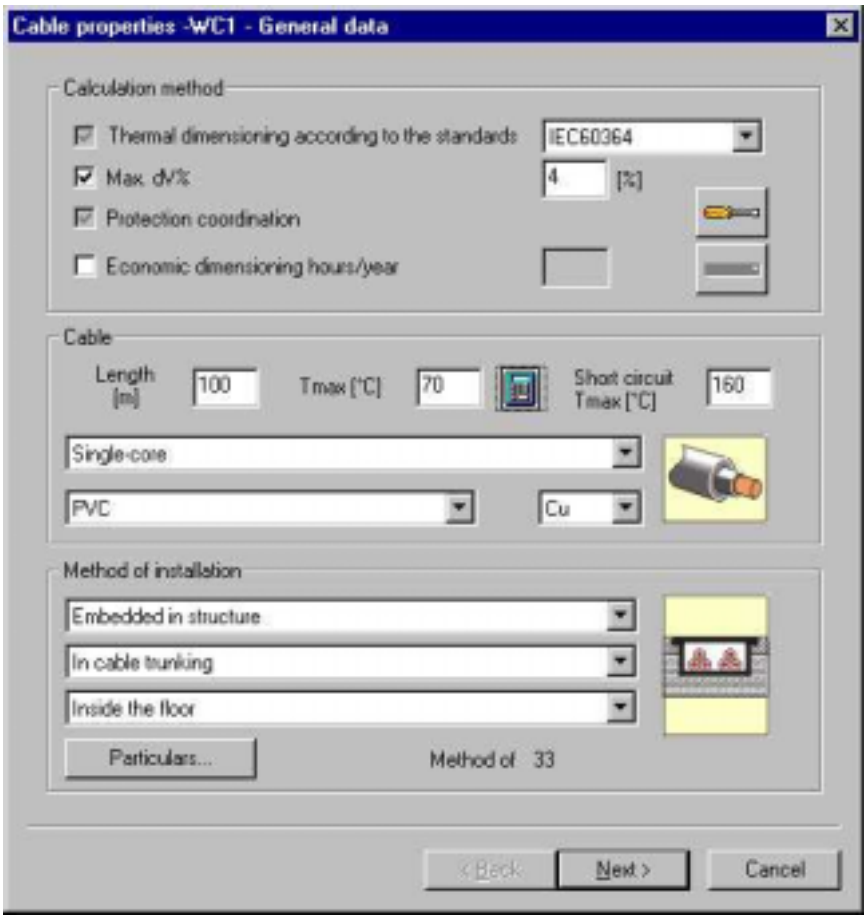
CABLE

CABLE DIMENSIONING

To dimension the line, enter the data in the panel shown below and select NEXT.

DOCWin will try to define up to four possible alternative solutions, with different cross-sections and number of conductors in parallel per phase. You can choose one of the four solutions, all of which are valid, and you can see in real-time their effect on subsequent calculation results.

It is possible that in certain circumstances it will not be possible to find four valid results. In that case, DOCWin will display fewer than four solutions.



METHODS USED TO DIMENSION PHASE CONDUCTORS

Thermal dimensioning
DOCWin always dimensions phase conductors in such a way that in continuous service they never exceed the maximum working temperature set (thermal dimensioning). This dimensioning can be performed using one of the standards listed below:

Installations in buildings
CEI 64-8, with reference to:
- **CEI UNEL 35024-1**: Cavi elettrici isolati con materiale elastomerico o termoplastico per tensioni nominali non superiori a 1000V in corrente alternata e a 1500V in corrente continua. Portate di corrente in regime permanente per posa in aria, 1997-06.

- **CEI UNEL 35024-2**: Cavi elettrici ad isolamento minerale per tensioni nominali non superiori a 1000V in corrente alternata e a 1500V in corrente continua. Portate di corrente in regime permanente per posa in aria, 1997-06.
- **CEI UNEL 35026**: Cavi di energia per tensione nominale U sino ad 1kV con isolante di carta impregnata o elastomerico o termoplastico. Portate di corrente in regime permanente. Posa in aria and interrata, 1982-12.
- **CEI UNEL 35027**: Cavi di energia per tensione nominale U sino ad 1kV con isolante di carta impregnata o elastomerico o termoplastico. Portate di corrente in regime permanente. Generalità per la posa in aria e interrata, 1982-12.

IEC 60364-5-523: Electrical installation of buildings.
VDE 298 Teil 4: Verwendung von Kabeln und isolierten Leitungen für Starkstromanlagen, 11/1998.
NFC 15-100: Installations électriques a basse tension. J, 1998.

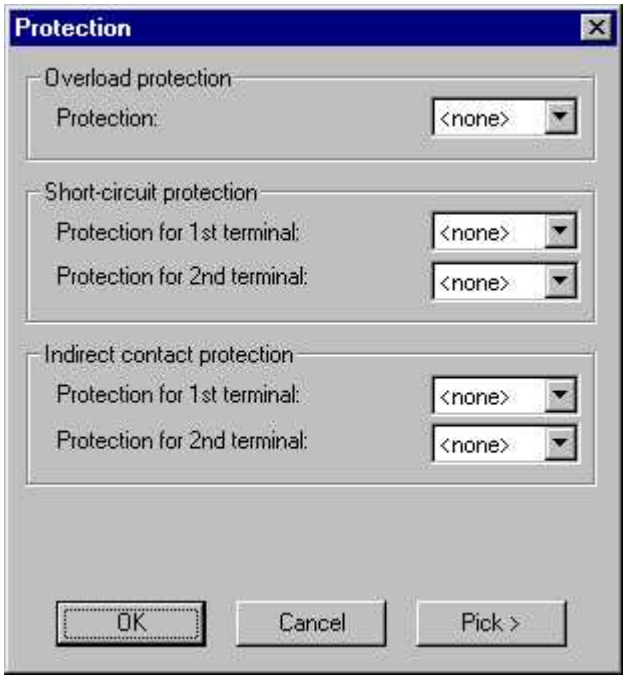
Switchboards
IEC 60890, Technical Report – Type 3, A method of temperature-rise assessment by extrapolation for partially-tested assemblies (PTTA) of low-voltage switchgear and controlgear, Am. 1, 02/1995.

Installations in ships
IEC 60092-352, Electrical installations in ships – choice and installations of cables for low-voltage power systems, II Ed.

Dimensioning for maximum voltage drop
In addition to thermal dimensioning, which is always done, you can set the maximum percentage voltage drop at the end of the line; phase conductor cross-section will be chosen so that the percentage voltage drop is always lower than the value set. The maximum value that can be entered is 10%.

In cases where control of maximum voltage drop has not been enabled, DOCWin will refuse solutions that involve a voltage drop of more than 10%.

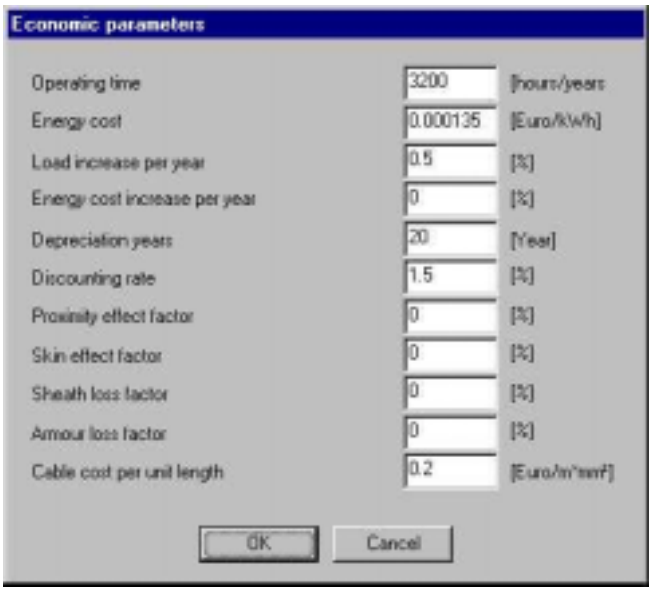
Coordination with protection
This function allows you to indicate which object is protecting the cable.
There are three different types of protection: overload protection, short-circuit protection and indirect contact protection.
To choose the type of protection you want, browse the list at the side that shows all types of protection (only compatible objects will be displayed).
In the case of short-circuit protection and indirect contact protection, either the first or second cable terminal can be protected.



Economic parameters
In addition to thermal dimensioning, which is always performed, and dimensioning for maximum voltage drop, which is optional, DOCWin can dimension conductors to optimize economic aspects of the installation. This optimisation can offer the customer significant cost savings, taking running costs for the installation into consideration as well as the actual installation costs.
The standard used is:
IEC 60287-3-2 Electric cables - Calculation of the current rating - Part 3: Sections on operating conditions - Section 2: Economic optimization of power cable size, 1995 - 06; adopted in Italy as Standard **CEI 20-43** Ottimizzazione economica delle sezioni dei conduttori dei cavi elettrici per energia, Ed. I, 09-1997.

The formulae, expressions, algorithms and data used make it possible to determine the economic cross-section for conductors using the method of economic conductor cross-section for an established load (article 5.2).

To modify parameters used in the calculations, press the button to the right of the box in which you can enter the number of hours a year the cable will be in service. The panel shown below will appear.



The parameters are:
- Maximum operating time lost through Joule effect [hours/year]
- Cost of one Watt / hour at the appropriate voltage level [Euro/Wh]
- Annual percentage load current increase [%]
- Annual energy cost increase not caused by inflation [%]
- Installation life [years]
- Depreciation rate [%]
- Proximity effect factor [%]
- Skin effect factor [%]
- Metal sheath loss factor [%]
- Armour loss factor [%]
- Variable component of cost per unit length related to conductor cross-section [Euro/m·mm^2]

All parameters in the panel have been set at reasonable values. Consult the reference standards before modifying these values.

OPTIMIZATION OF NEUTRAL OR PEN CONDUCTORS
Neutral or PEN conductors are dimensioned in accordance with **CEI 64-8/5 art.524.**

In summary:
- for copper conductors and phase cross-section up to 16 mm^2, neutral cross-section is equal to phase cross-section;

- for copper conductors and phase cross-section over 16 mm^2, neutral cross-section is equal to the larger of 16 mm^2 and half the phase cross-section;
- for aluminium conductors and phase cross-section up to 25 mm^2, neutral cross-section is equal to phase cross-section;
- for aluminium conductors and phase cross-section over 25 mm^2, neutral cross-section is equal to the larger of 16 mm^2 and half the phase cross-section;

DIMENSIONING OF PE CONDUCTORS

PE conductors are dimensioned in accordance with **CEI 64-8 art.543.**
Briefly:

- for phase cross-sections up to 16 mm^2 and in the absence of mechanical protection, maximum PE cross-section is equal to the larger of 4 mm^2 and the phase cross-section;
- for phase cross-sections up to 16 mm^2 and in the presence of mechanical protection, PE cross-section will be equal to the larger of 2.5 mm^2 and the phase cross-section;
- for phase cross-sections between 16 mm^2 and 35 mm^2, PE cross-section is equal to 16 mm^2.
- for phase cross-sections over 35 mm^2, PE cross-section is equal to half phase cross-section.

Properties of PE conductors, when present, are set in the PE DEFINITION panel in the CIRCUIT panel.

PARAMETERS USED FOR DIMENSIONING

The parameters used in the calculation procedure are contained in the '*Cable'* and '*Method of installation'* boxes in the 'General data' panel, as well as in the 'Circuit' panel. The available values change as the selected method of calculation changes. For further explanation of the significance of individual data to be entered, see the reference standards.

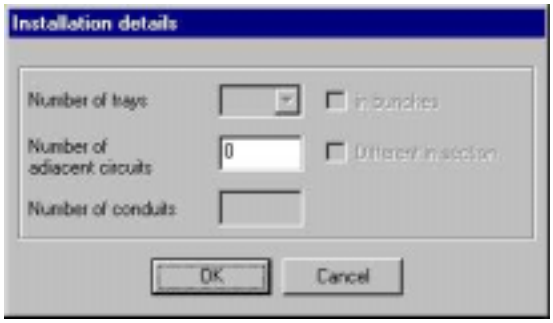
Cable data
Set the properties for the cable you want using in the '*Cable*' area
Cable properties are:

- Type
- Conductor material
- Isolator material
- Maximum temperature permitted in continuous operation.

Type, Conductor material, Isolator material and Maximum temperature permitted in continuous service change as standards are changed.

Method of installation
Methods of installation vary form standard to standard. Select the method you want by selecting in sequence, from top to bottom, from the combo in the 'Method of installation' area

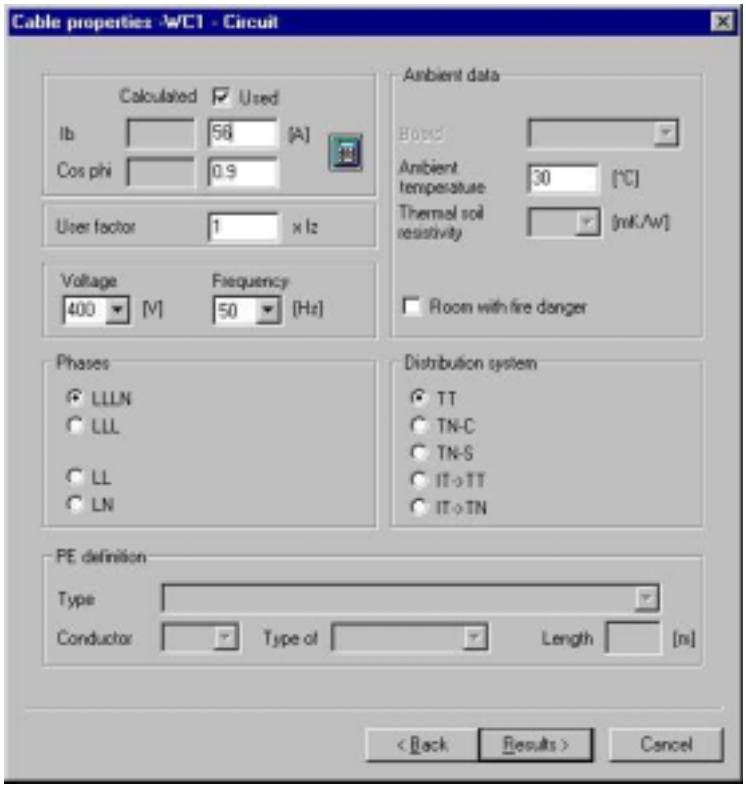
When the '*Particulars'* button is available, you can set additional parameters, which vary from standard to standard.
The illustration below refers to IEC 60364.



The data requested in this panel can have a significant effect on the calculation results; they have initially been set to reasonable values. You are recommended to consult reference standards before changing them.

Circuit data

The 'Circuit', panel, illustrated below, allows you to set circuit data and enter the line to be dimensioned.



CIRCUIT PARAMETERS

Circuit parameters are:

Ambient data

Ambient data are:

- Ambient temperature: this is automatically preset in accordance with the current standard; however, it can be modified within the limits allowed by the standard itself.
- Room with fire danger. These settings affect only coordination with protection.
- Thermal soil resistivity.

Phases

Three-phase and two-phase circuits are included, with and without neutral, as well as single-phase.

Distribution system

Circuits included are TT, TN-C, TN-S, IT which become TT, and IT which become TN. These settings only affect coordination with protection.

Rated voltage

Choose one of the values given in the drop-down list, or type in the value you want (between 1 and 1000 V).

Load current

This is the current that has to flow down the line. The current can be defined automatically from network properties.

Power factor (cos phi)

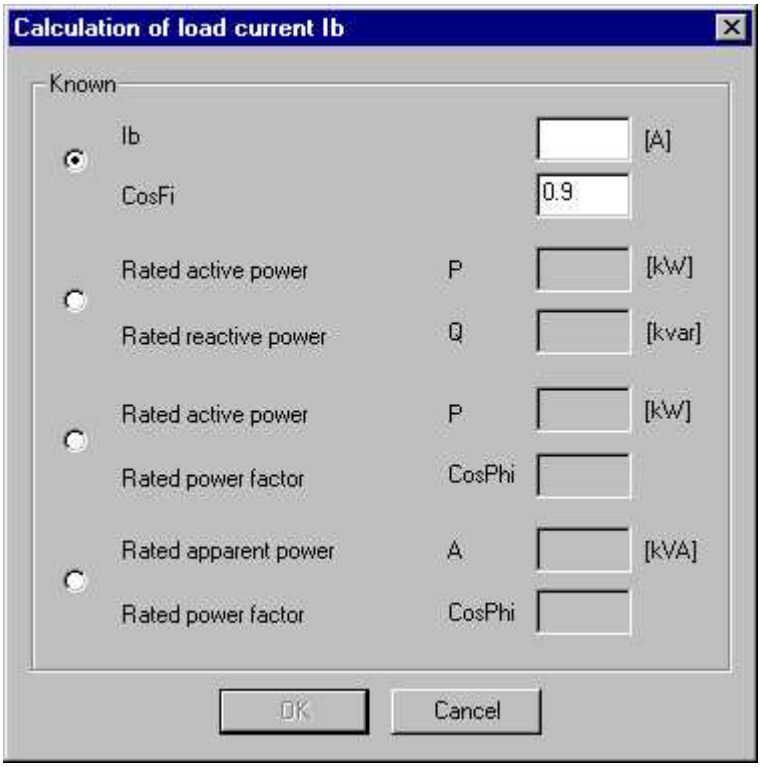
This is the actual power factor of the load served by the line. This factor can be defined automatically from network properties.

Calculation of load current I_b

Load current and power factor can be obtained from other known data, by pressing the *Calculate* button.

The methods of calculation used to obtain I_b and cos phi are:

- known rated active power and rated reactive power
- known rated active power and rated power factor
- known rated apparent power and rated power factor.



When you have selected the method you want, type in data that has to be entered and press *OK*: the calculated values will automatically insert.

User factor

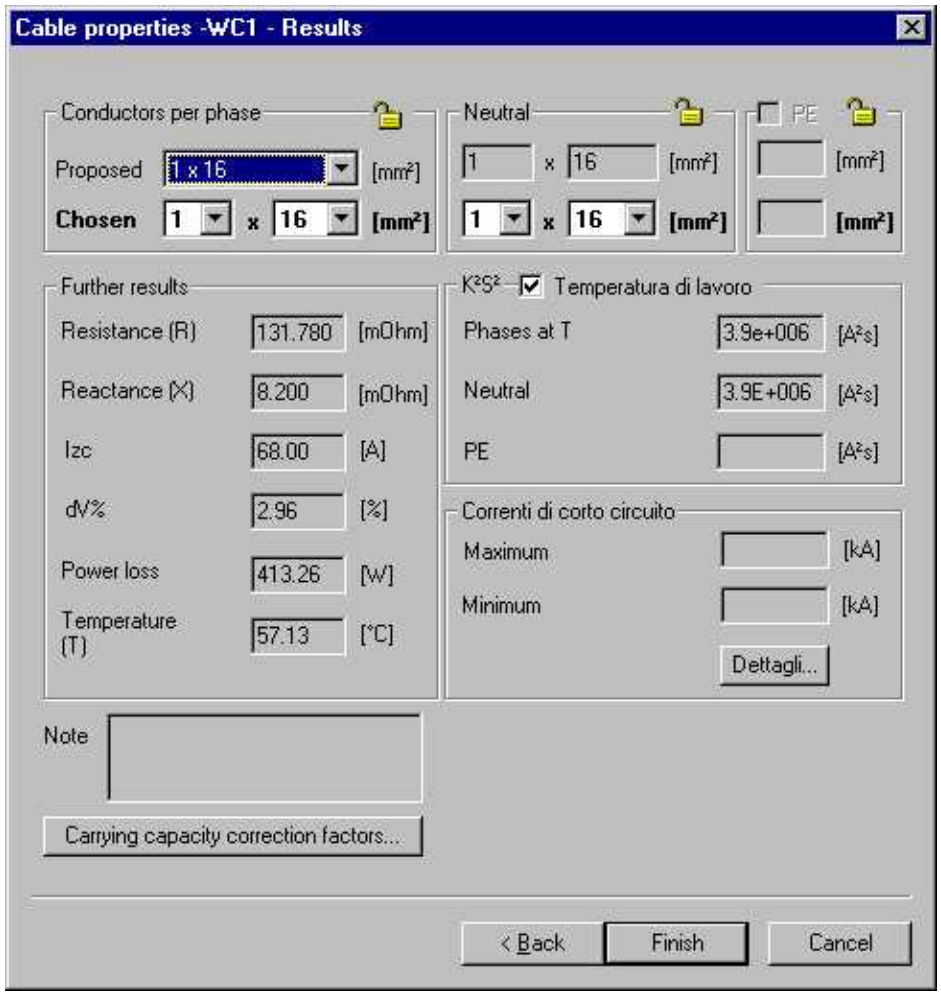
The user factor is a value left to the discretion of the design engineer. Correction factors K for current-carrying capacity, calculated by the program, are multiplied by this user factor. This allows the design engineer to force the calculation results, by increasing or decreasing the calculated current-carrying capacity of cables.

PE Definition

Properties of PE conductors, when present, can be set in the '*PE Definition*'

RESULTS OF DIMENSIONING

To read the dimensioning results, after the physical and electric properties insertion of the cable, click on the 'Results' button to view the panel illustrated below.



Values calculated are:

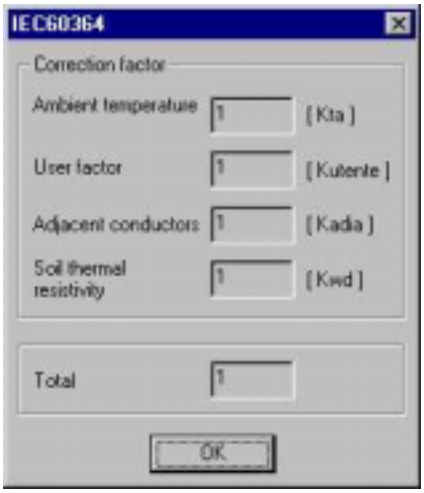
- Phase conductor configuration (up to four alternative solutions)
- Neutral conductor configuration
- PE cross-section
- Phase conductor current-carrying capacity (after application of appropriate correction factors)
- Percentage voltage drop at the end of the line
- Cable resistance at working temperature in continuous service
- Cable reactance
- Working temperature in continuous service
- Power loss by cable
- Specific let-through energy of phase conductors
- Specific let-through energy of neutral conductors
- Specific let-through energy of PE
- Maximum length protected against short-circuit
- Maximum length protected against indirect contacts.

The values proposed for phase, neutral and PE conductors can be changed by the design engineer, even outside the range of solutions proposed; after they have been changed, the necessary verification is performed automatically and any problems encountered are displayed.

All values that can be changed can be “locked” by pressing the appropriate padlock icon. This locking prevents the values that have been set from automatic modification by the program during automatic network calculation procedures.

Carrying capacity correction factors

This panel allows you to access current-carrying capacity correction factors, calculated on the basis of the standard selected. Data are made available to facilitate any verification of the accuracy of the results proposed. The panel illustrated below refers to standard IEC 60364.

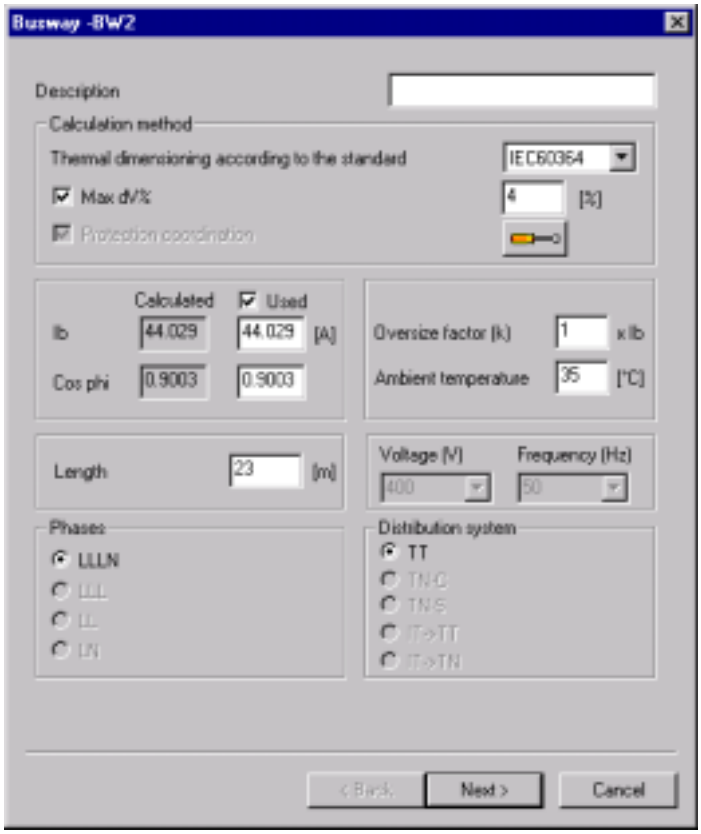


VERIFICATION

The DOCWin calculation module can be used to verify existing lines. You only have to set the parameters for the line to be verified, then go to the resultspanel and force the phase, neutral and PE (or PEN) conductors to the known configurations; then check the verification results.

BUSWAY

DOCWin sizes automatically the busways (Busbar trunking systems) during the automatical calculation of the net. It is also possible to size manually the busway.
Use the '*Properties*' command to open the dialog shown in the figure below.



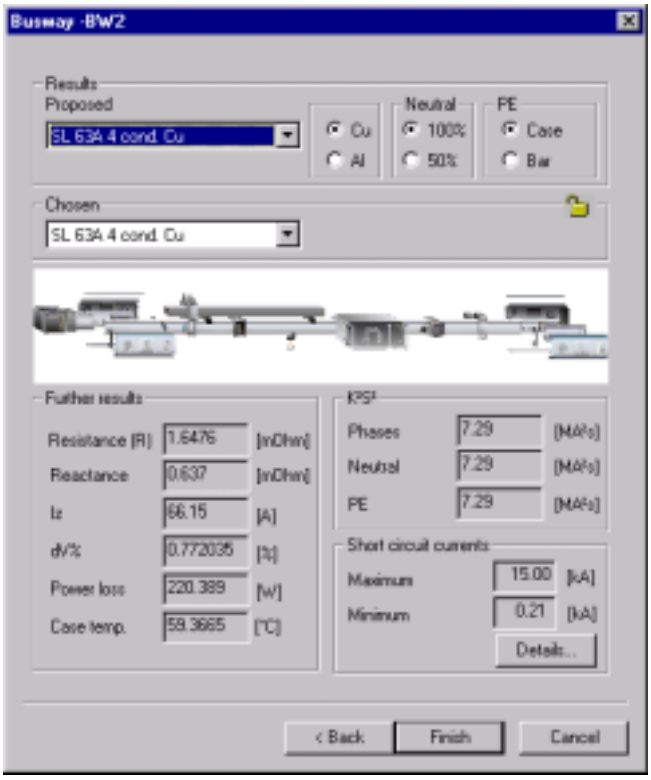
DOCWin sizes the busways according to :

- **IEC 60364**: Electrical installation of buildings;
- **CEI 64-8**: Impianti elettrici utilizzatori.

It is possible to set a maximum allowed voltage drop.
Insert the lenght of the busway,the ambient temperature and the oversize factor. Use this one to force the calculated (or the inserted) load current in order to reach a convenient reserve if necessary.
Click on '*Finish'* to size automatically the busway. In this case the protection of the busway is also checked by the program. In particular DOCWin verifyes the specific let-through energy and the peak of the protecting device at the maximum short circuit current.
Click on the 'Used' check-box to insert a load current manually and to size off-line the busway. In this case, clicking on '*Next*' is possible to read the results. DOCWin proposes all the valid busways ordered by price. The user can filter the proposed solutions according by:
- conductive material (Cu or Al);
- cross-section of the neutral conductor (50% or 100% of the cross-section of the phases conductors);
- the type of PE conductor (Case or Bar).

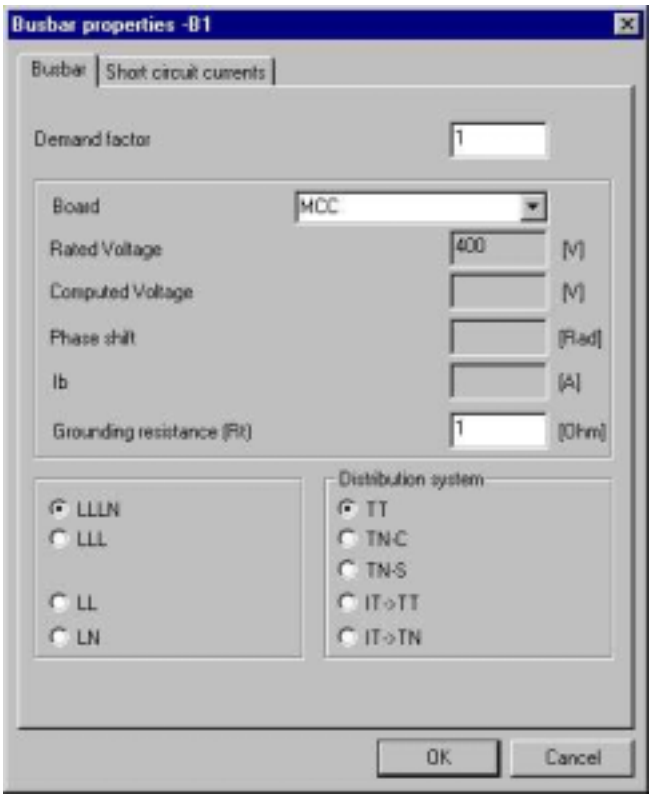
In the lower part of the window are shown further results:

- resistance and reactance;
- carrying capacity;
- voltage drop;
- losses;
- case working temperature;
- specific energy of phases, neutral and PE;
- the maximum and the minimum value of the short circuit currrent.

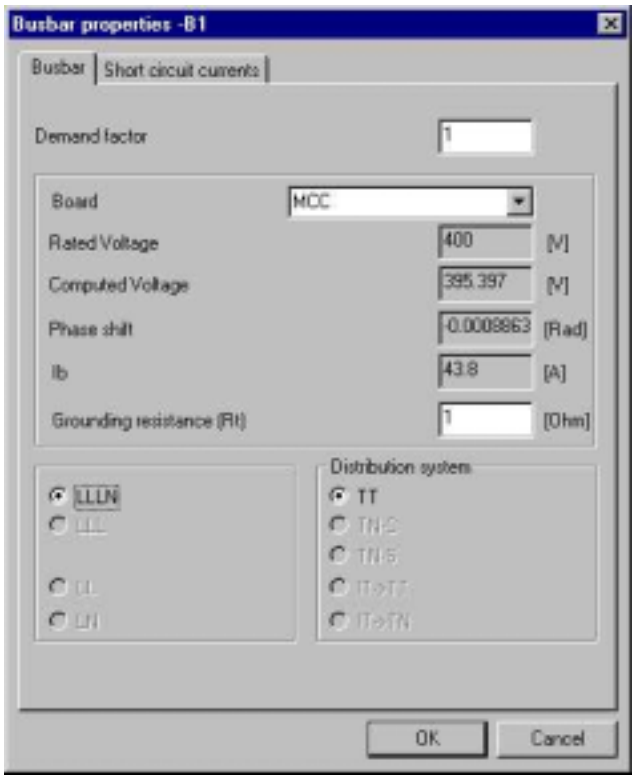


BUSBAR

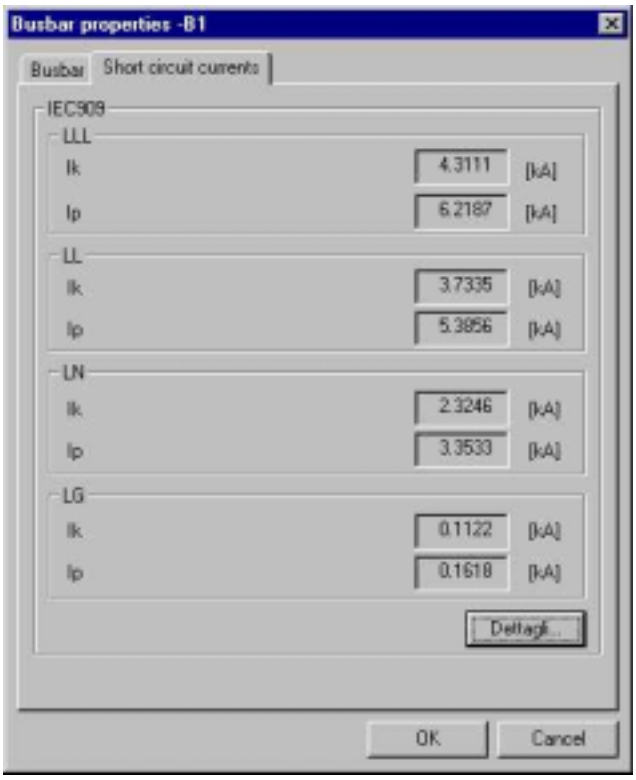
The busbar object represents a network power flow switching node.
In the '*Busbar properties'* panel, set the demand factor coefficient and switchboard name, if any, and grounding resistance. Rated voltage, phases and distribution system are inherited from the upstream object to which the busbar has been attached.



Once the automatic calculation procedure has been initiated, the power flow (Load-Flow) calculation results are displayed in the window: voltage, phase shift and current.



Calculated short-circuit current values are displayed in the '*Short-circuit currents*' panel.



The *Details* command displays all the other short-circuit current values (see section dealing with short-circuit currents).

CONNECTION

This does not represent a real object. It is an exclusively graphic entity which can be useful during drawing to allow you to avoid direct connection between two objects or parts of the installation and to increase spacing with respect to the predefined grid.

INCOMING FEEDER

This does not represent a real object. It is an exclusively graphic entity which can be useful for drawing different parts of the installation on the page.
The properties panel allows you to name the object. In practice, the object '*Incoming feeder*' should always be associated with an '*Outgoing feeder*' with the same name. This is the only way in which DOCWin can reconstruct the exact layout of the network.

OUTGOING FEEDER

This does not represent a real object. It is an exclusively graphic entity which can be useful for drawing on different parts of the installation on the pages.
The properties panel allows you to name the object. In practice, the object '*Outgoing feeder*'' should always be associated with an '*Incoming feeder*' with the same name. This is the only way in which DOCWin can reconstruct the exact layout of the network.

CIRCUIT BREAKER

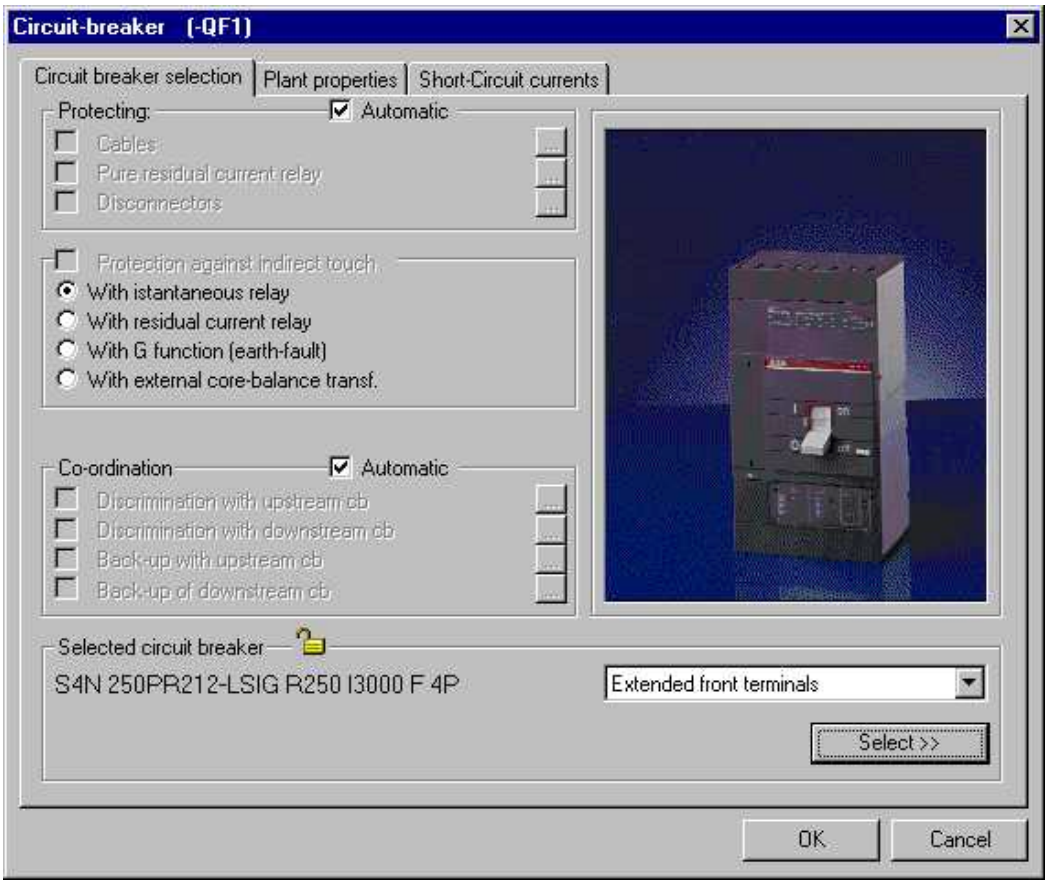
General

DOCWin automatically chooses a circuit-breaker once calculation and automatic dimensioning have been initiated. The circuit-breaker is chosen on the basis of default data concerning cable protection, protection of individuals, etc. This data can be entered before automatic calculation is initiated, according to project requirements, by using the '*PROPERTIES*' command.
The circuit breaker can also be chosen off-line, i.e. without initiating the automatic calculation, again by using the '*PROPERTIES*' command.
The circuit-breaker interface consists of three panels:
- *Circuit breaker selection*
- *Plant properties*
- *Short-circuit current*

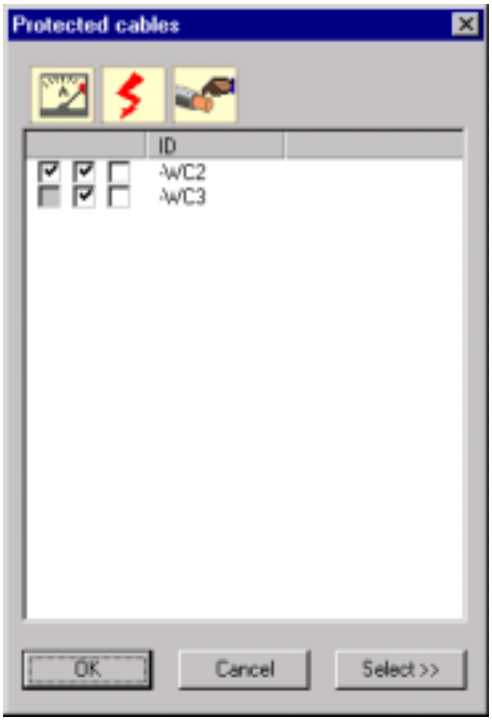
Circuit-breaker selection

In this panel you choose the objects to be protected, the protection functions to be implemented, and coordination with other circuit-breakers, if any.
The circuit-breaker can protect:
- Cables;
- Capacitor banks
- Pure residual current relays
- Disconnectors

If you select *Automatic,* DOCWin will automatically associate the circuit-breaker with the objects to be protected according to the following criteria:
- an object to be protected against overload must be in series with the circuit-breaker;
- it must be possible for a circuit-breaker to isolate an object which is to be protected against short-circuit and indirect contact from *all* sources of supply (Utility and Generator).



If you deselect *'Automatic'*, you will be able to press the button on the right of the category of objects to be protected and manually select the objects to be protected.
For cables, you can choose various devices which protect the cable against overload, short-circuits and indirect contacts.
DOCWin excludes circuit-breakers which cannot protect the cable against overload, or against short-circuits and indirect contacts.
The command '*Select* allows you to choose the cable to be protected directly on the schematic that has been drawn.



As shown in the figure, the *Selection of Protection Cables* command shows all cables which can be protected by the circuit-breaker in question.
Select the type of protection:

	Overload protection	DOCWin chooses the protection device on the basis of the conditions given in Standard CEI 64/8-4, article 433: $I_b \le I_n \le I_z$ $I_f \le 1.45\ I_z$ where: I_b : system current; I_n : rated current of the protection device; I_z : continuous current-carrying capacity; I_f : current that ensures effective operation of the protection device within a standard time under defined conditions
	Short-circuit protection	DOCWin chooses the protection device on the basis of conditions in the Standard CEI 64/8-4 article 434: - the breaking capacity should not be lower than the presumed short-circuit current at the point of installation; - the specific let-through energy of the circuit-breaker (I^2t) must be lower than the energy that can be withstood by the conductor (K^2S^2).
	Indirect contacts protection	DOCWin chooses a protection device with automatic interruption of supply on the basis of the conditions given in Standard CEI 64/8-4, article 413, relating to the distribution system:
	TT distribution system $R_t \le \frac{50}{I}$ where: R_t : sum of the resistance of the electrode and of the protection conductors of exposed conductive parts; I : trip current within 5 seconds of the protection device that can be measured from the trip characteristics of the device itself	
	TN distribution system $Z_s \cdot I_a \le U_0$ where: Z_S : impedance of the fault ring which consists of the source, conductor active up to the fault point and protection conductor between fault and source; U_0 : rated voltage between phase and installation earth I_a : trip current of the protection device within a defined time in relation to rated voltage U_0 or, for distribution circuits (and in other conditions specified by the standards), a standard time not longer than 5 s; if a pure residual current relay is used, I_a is the differential current I_{dn}.	

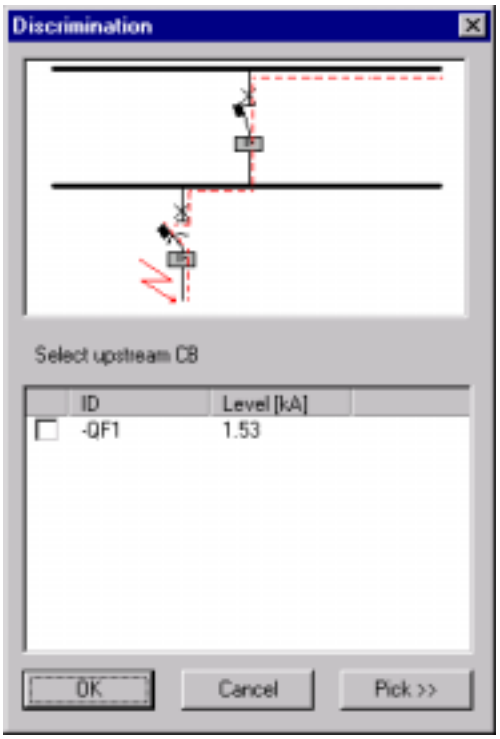
	IT distribution system The standard specifies that the circuit must be broken if a second earth fault occurs in the following way: a) when the exposed conductive parts are earthed in groups or individually, conditions for protection are similar to those described for the TT system b) when the exposed conductive parts are interconnected collectively by a protection conductor, the specifications relating to the TT system apply, in particular: when there is no neutral, check that: $Z_s \leq \frac{U}{2 \cdot I_a}$ when there is neutral, check: $Z'_s \leq \frac{U_0}{2 \cdot I_a}$ where U_0 is the rated voltage between phase and neutral; U is the rated voltage between phase and phase; Zs is the impedance of the fault ring consisting of the phase conductor and the circuit protection conductor; Z's is the impedance of the fault ring consisting of the neutral conductor and the circuit protection conductor;

For pure residual current relay disconnectors and circuit-breakers you can choose a device which protects against short-circuits and against overload. DOCWin excludes circuit-breakers which cannot protect the disconnector.

You can choose one of the two modes described below to define protection from indirect contacts:
- W*ith instantaneous relay*: the circuit-breaker will be chosen with regard only to overcurrent;
- *With pure residual current relay:* the circuit-breaker will be chosen by coupling it with the residual-current release;
- *Against earth-fault*: a circuit-breaker with electronic release with function G (protection against earth fault with delayed trip) will be chosen.
- *With external core-balance transformer:* an external core-balance transformer will be coupled to the circuit-breaker for the earth conductor of the principal supply (transformer star centre)

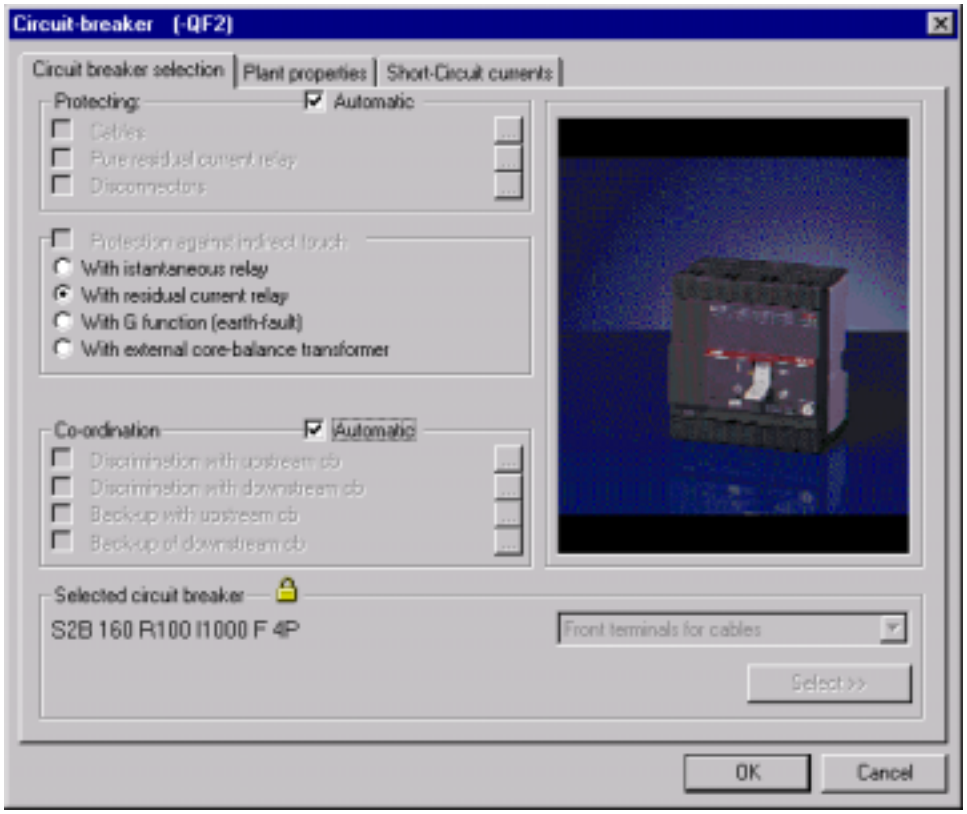
In the *Co-ordination* box, choose discrimination or back-up with other upstream or downstream circuit-breakers.

If you select the *Automatic* box, DOCWin automatically sets discrimination and back-up constraints.
If you deselect *Automatic,* the protection desired can be set using the appropriate dialogue boxes.

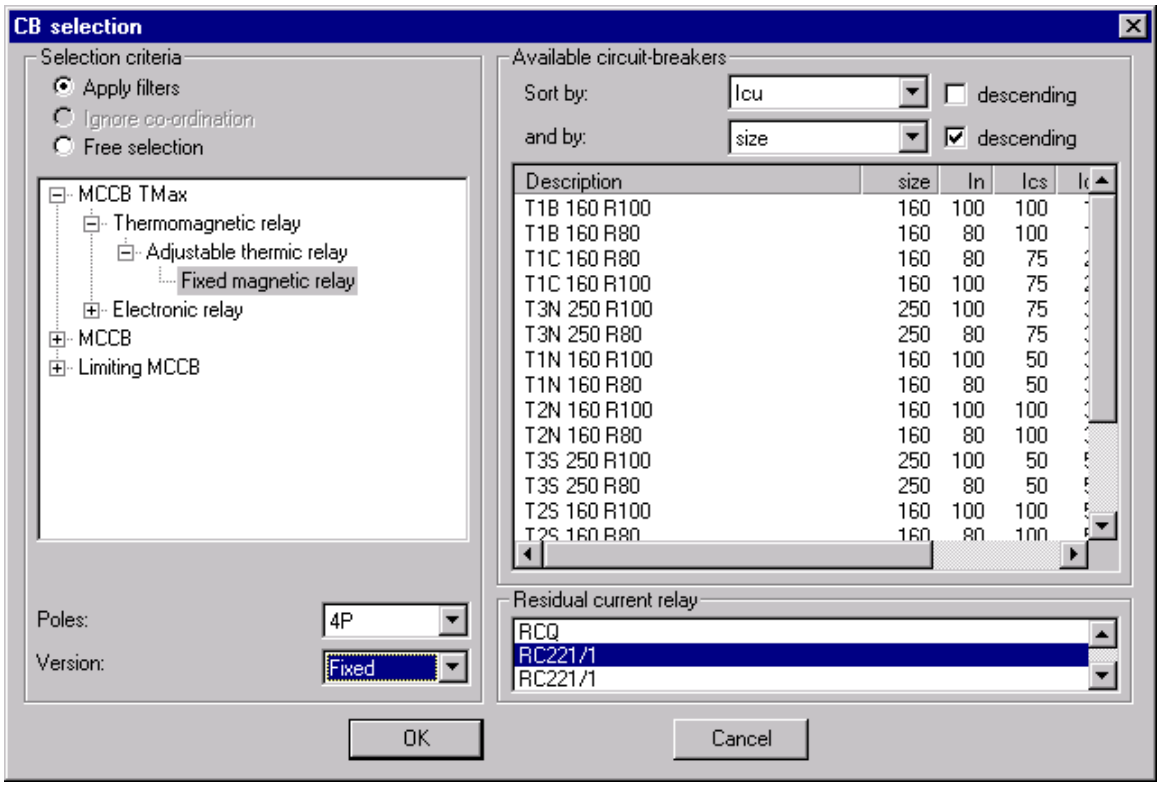


The '*Selected circuit-breaker*' panel displays the current circuit-breaker, and you can define its terminals and if necessary, lock the choice with the padlock.
In this mode, DOCWin will no longer be able to modify the choice of circuit-breaker if it has to redo the calculations in the project refinement phase.

Nota bene
Keep a note of objects that have been locked by the padlock. DOCWin will not modify the choice even if the objects should become unsuitable in the light of modifications made to the network after the circuit-breaker has been locked.



The current circuit-breaker can be changed by pressing the 'S*elect'* button



The circuit-breaker can be chosen by selecting one of the following three criteria in the top left part of the panel :

- *Apply filters*;
- *Ignore coordination*;
- *Free selection*.

If you select *Apply filters,* DOCWin will display all the circuit-breakers that satisfy the requirements set during the last stage, with the number of poles and version chosen via the drop-down menus with the same names.

The abbreviations used to describe the different versions are:
- F: fixed circuit-breaker
- P: plug-in circuit-breaker
- W: withdrawable circuit-breaker

If you select *Ignore coordination,* DOCWin will display the circuit-breakers that satisfy the requirements set during the last stage, except the constraints imposed by coordination of back-up and discrimination.

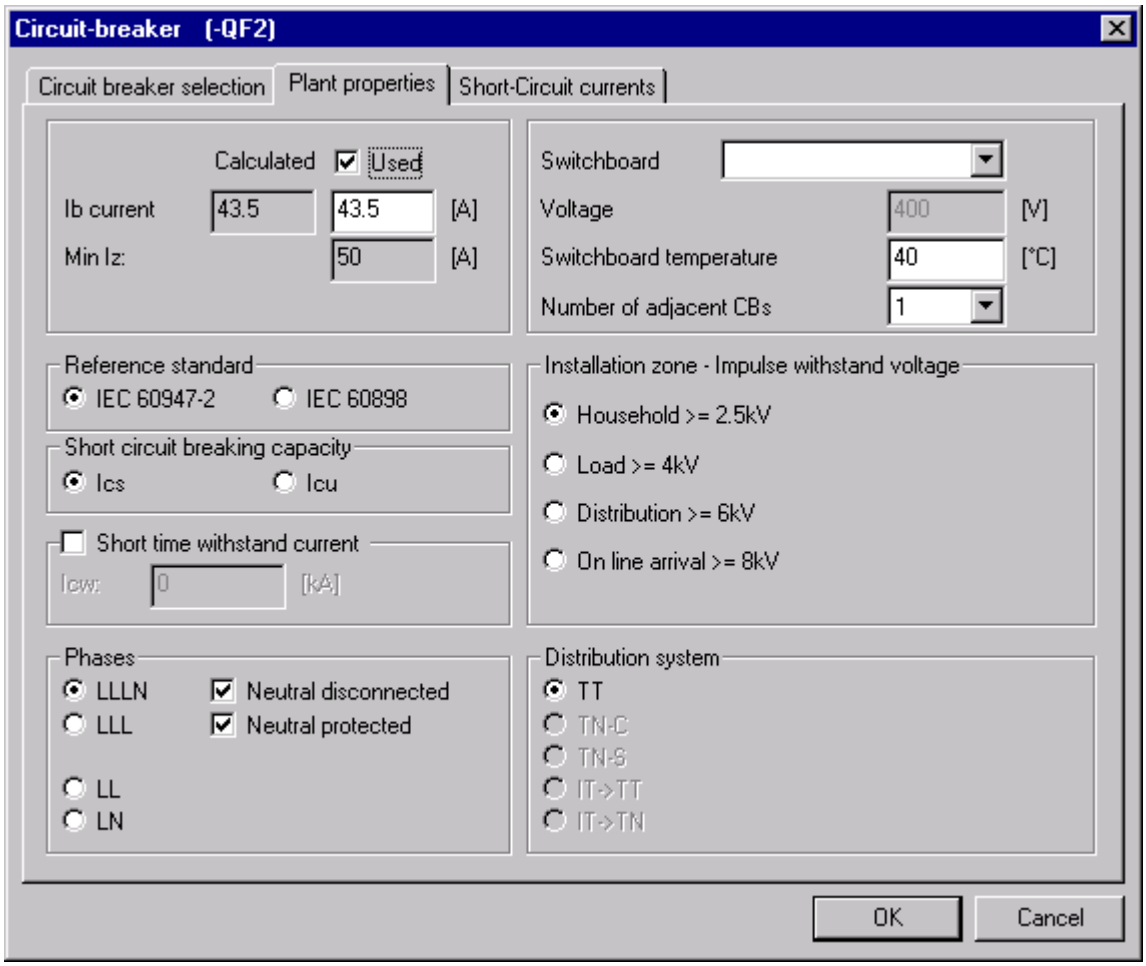
If you select *Free selection,* DOCWin will display ALL circuit-breakers available in the database which are compatible with the number of poles and versions chosen.

Whichever option is selected, to facilitate the search, DOCWin displays circuit-breakers in a tree structure so that you can select by category.

If necessary, once a suitable circuit-breaker has been selected, you can select the residual-current relay from the list shown in the *Residual-current relay* panel.

Plant properties

The *Plant properties* panel is used to set properties for the plant in which the circuit-breaker is to be installed.



I_b current is the current which crosses the circuit-breaker.
The value calculated by DOCWin is shown in the box on the left; select the *'Used'* box to enter the value desired (this option is useful for off-line circuit-breaker selection).

Minimum Iz is the minimum carrying-capacity of protected objects.

DOCWin allows you to choose a circuit-breaker which complies with standard IEC 60947-2 (circuit-breakers for industrial use) and with standard IEC 60898 (circuit-breakers for domestic and similar use)

Standard IEC 60947-2 defines the maximum breaking capacity I_{cu} and service breaking capacity I_{cs}, while standard IEC 60898 defines the rated short-circuit capacity I_{cn} and service capacity I_{cs}

If necessary, you can define a short term withstand current.

To make the right choice, you should take into account the temperature of the switchboard on which the circuit-breaker will be located; for circuit-breakers for domestic and similar use, you should also take into account the number of adjacent circuit-breakers.

The impulse withstand voltage specified by the standards varies according to the installation zone

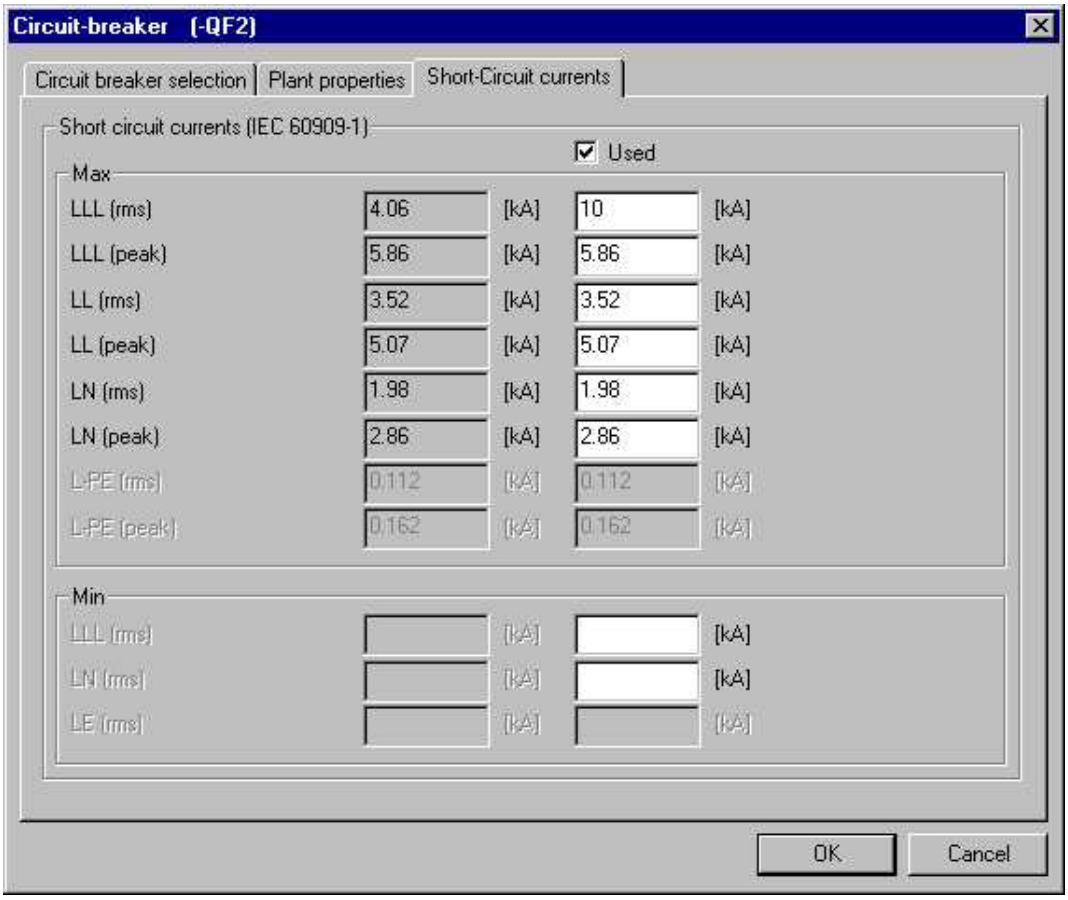
If you are allowed to disconnect neutral, the *Neutral disconnected* box will be activated; if selected, a four-pole circuit-breaker will be chosen. If you do not want to disconnect neutral but generally want to provide protection against earth faults, select only the *Neutral protected* box; in this case a three-pole circuit-breaker will be chosen (but a toroid will be specified for the neutral conductor external to the circuit-breaker). Obviously if neutral is disconnected it will also be protected.

Data on the distribution system is inherited from the network, but you can also set it.

Selecting the TN-C distribution system disables the *Neutral interrupted* box. In this case the standards prohibit disconnection of the neutral conductor.

Short-circuit currents

The panel allows you to view and/or set short-circuit currents at the point in the plant where the circuit-breaker is installed.
On the left, values calculated by DOCWin are displayed, based on the standard selected for the calculation. On the right, you can manually enter values higher than those calculated to perform interim dimensioning or to take account of the future development of the plant.



DOCWin uses the following method to calculate maximum and minimum short-circuit currents:
- Symmetrical components method
- Standard IEC 60909-1
- Standard IEC 61363-1

The symmetrical components method is used to calculate the value of the symmetrical short-circuit current and the maximum and minimum peak value.
Standard IEC 60909-1 applies to calculation of short-circuit currents:
- In alternating current (AC) low and medium voltage three-phase networks
- In high voltage three-phase AC networks with rated voltage up to 380 kV and frequency 50Hz or 60Hz

Standard IEC 61363-1 applies to calculation of short-circuit currents in shipboard installations and fixed or moving marine platforms with exclusively radial networks.
Select the *Used* box to enter the values required for short-circuit currents. DOCWin does not allow you to enter a value lower than the calculated value.

FUSE

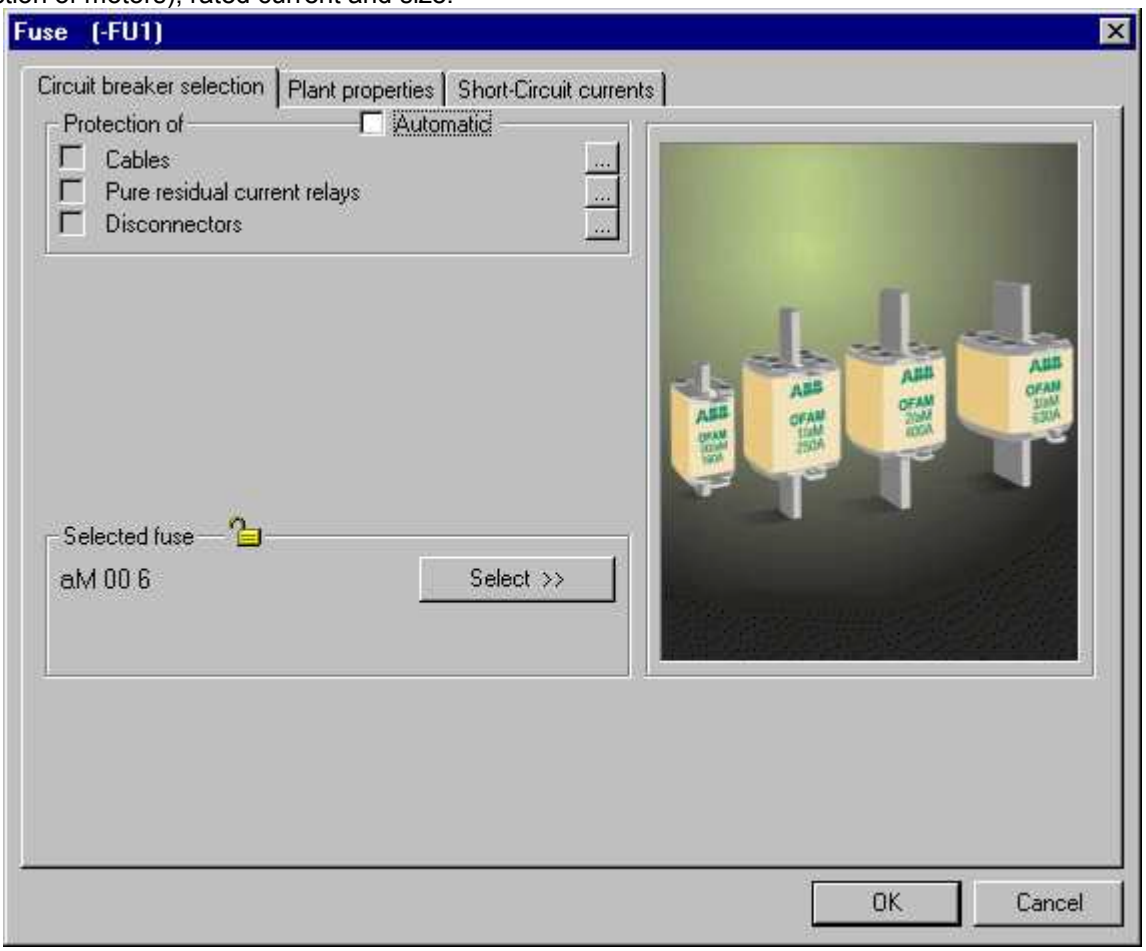
General

The fuse interface consists of two panels:

- *Fuse selection*;
- *Plant properties;*
- *Short-Circuit currents.*

DOCWin automatically chooses a fuse once automatic calculation and dimensioning have been initiated. The fuse is chosen on the basis of default data concerning cable protection, protection of individuals etc. These data can be entered before automatic calculation is initiated, according to project requirements, using the *PROPERTIES* command.

The fuse can also be chosen off-line, without initiating the automatic calculation, again by using the *PROPERTIES* command. To select the fuse manually, enter the type of fuse-link (gG: general use, aM: protection of motors), rated current and size.

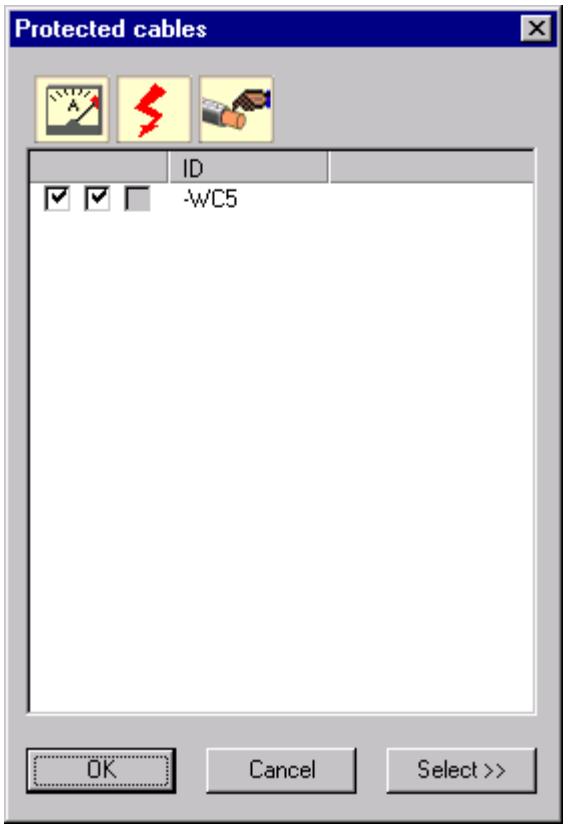


Fuse selection

In this panel you select the objects to be protected and the protection functions to be implemented.
A fuse can protect:
- Cables;
- Contactors
- Disconnectors

If you select *Automatic,* DOCWin will automatically associate the fuse with the objects to be protected according to the following criteria:
- an object to be protected against overload must be in series with the fuse;
- it must be possible for a fuse to isolate an object which is to be protected against short-circuit and indirect contacts from *all* sources of supply (Utility and Generators).

If you deselect *Automatic*, you will be able to press the button on the right of the category of objects to be protected and manually select objects to be protected.

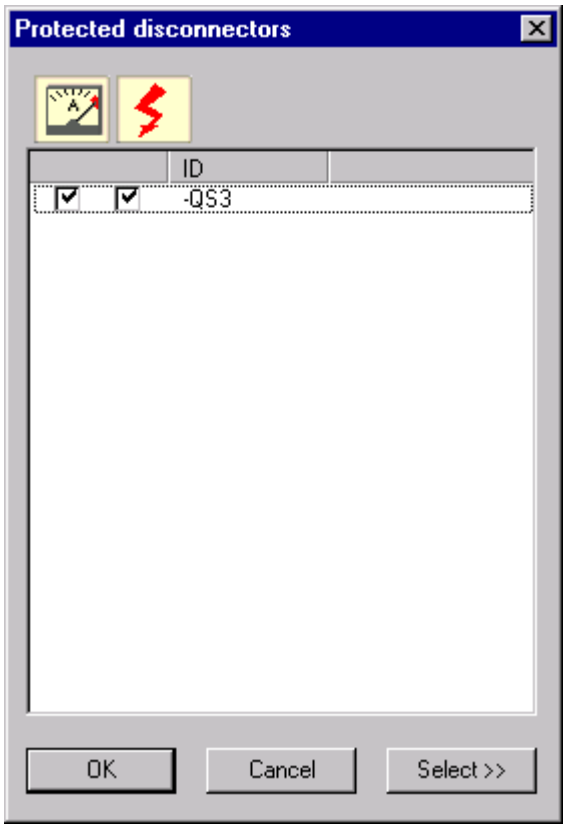


As shown in the figure, the '*Selection of protected cables'* window shows all cables which can be protected by the fuse in question.
The '*Select'* command allows you to select a cable to be protected directly on the schematic that has been drawn.

Select the type of protection:

	Overload protection	DOCWin selects the protection device on the basis of the specifications given in Standard CEI 64/8-4, article 433: $I_b \leq I_n \leq I_z$ $I_f \leq 1.45\ I_z$ where: I_b : system current; I_n : rated current of protection device; I_z : continuous current-carrying capacity of the conductor; I_f : fusion current in standard time.
	Short-circuit protection	DOCWin selects the protection device on the basis of the specifications given in Standard 64/8-4, article 434: - the trip power must not be lower than the presumed short-circuit current in the installation point; - the specific let-through energy of the fuse (I^2t) should be lower than the energy that can be withstood by the conductor (K^2S^2).
	Indirect contacts protection	DOCWin selects the device providing protection by automatic interruption of supply on the basis of the specifications given in Standard CEI 64/8-4 article 413 relating to the distribution system. Compare with section 0

For disconnectors you can select devices that protect against overload and short-circuit .



For protection of people, DOCWin applies the specifications of Standard CEI 64/8-4 article 413 according to the distribution system, in a similar way to the protection against indirect contacts in the '*Selection of protected cables'* window.

The fuse chosen can be locked with the padlock. In this mode, DOCWin will no longer be able to modify the choice of fuse if it should be necessary to redo calculations during the project refinement stage.

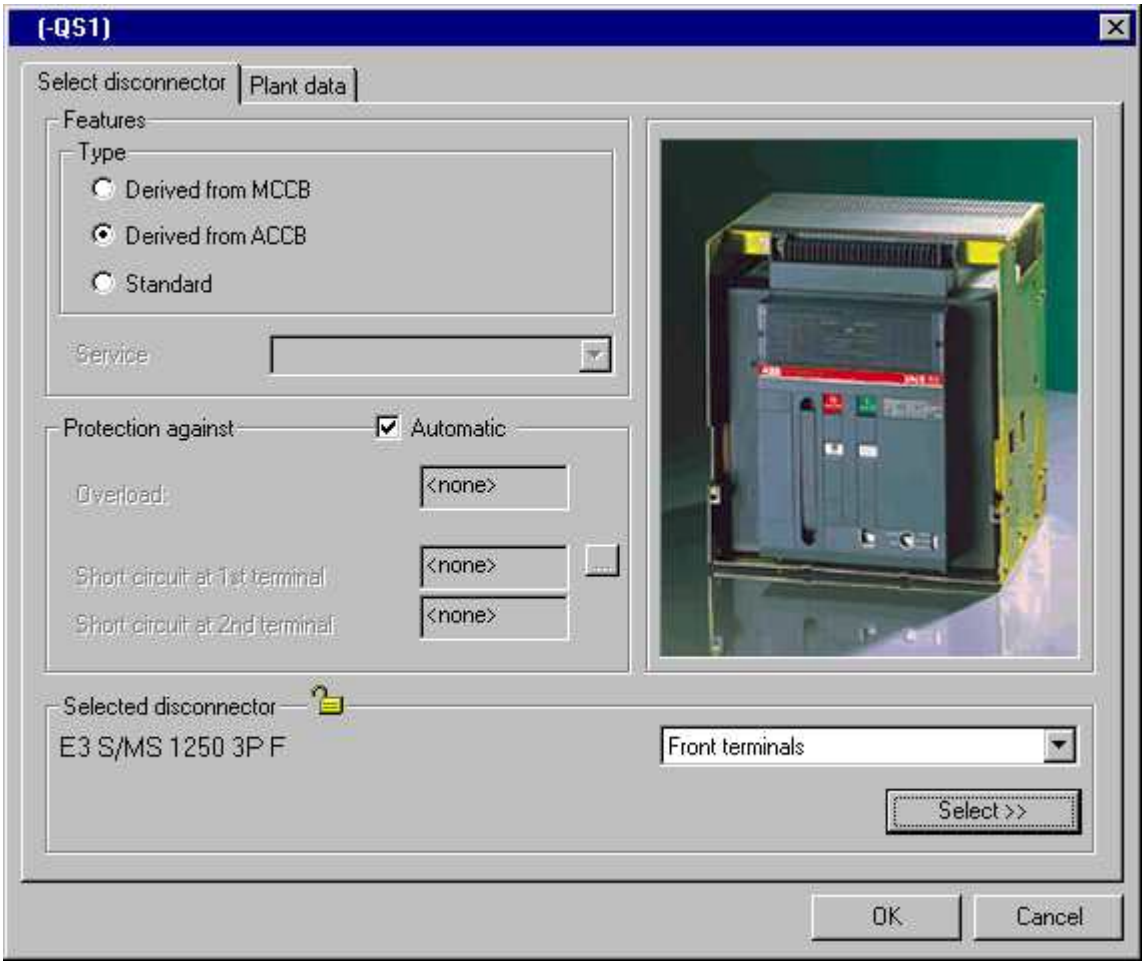
Nota bene
Keep a note of the objects that have been locked with the padlock. DOCWin will not modify the choice even if the objects should become unsuitable in the light of modifications made to the network after the fuse has been locked.

DISCONNECTOR

General

DOCWin automatically chooses a disconnector once automatic calculation and dimensioning have been initiated. The disconnector is chosen on the basis of default data concerning the properties of the overload short-circuit protection device. These data can be entered before automatic calculation is initiated, according to project requirements, using the *PROPERTIES* command.
The disconnector also be selected off-line, without initiating automatic calculation, again using the *PROPERTIES* command.
The disconnector interface consists of two panels:

- *Select disconnector*
- *Plant data*



Select disconnector

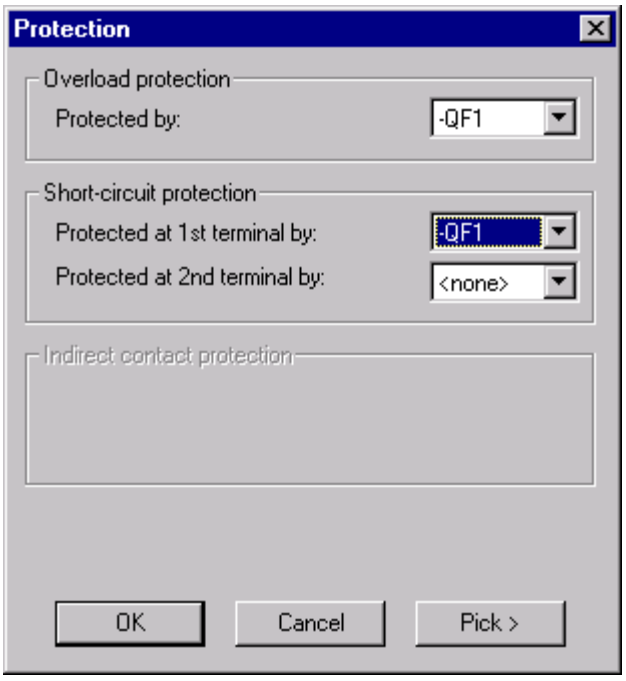
This panel is used to select the properties of the disconnector and the protection device capable of protecting it from short-circuit and overload.

The type of disconnector is selected in the *Features* panel:
- *'Derived from MCCB'* is a disconnector from the Isomax moulded-case range
- *'Derived from ACB'* is a disconnector from the open Emax range of circuit-breakers
- *'Standard'*: OT/OETL series disconnector

The '*Service'* box lists disconnector usage categories according to table II-2 of the Standard CEI EN 60947-3

The '*Protection against'* box displays and sets devices which are to protect the disconnector from short-circuit and from overload.

If '*Automatic'* is selected, DOCWin will choose the disconnector, automatically coordinating it with the circuit-breaker immediately upstream (or with a number of circuit-breakers if the disconnector is supplied from both sides)
If you deselect '*Automatic'* you can tell the program which circuit-breakers to consider for protecting the disconnector; the '*Select'* button allows you to select circuit breakers directly on the schematic that has been drawn.

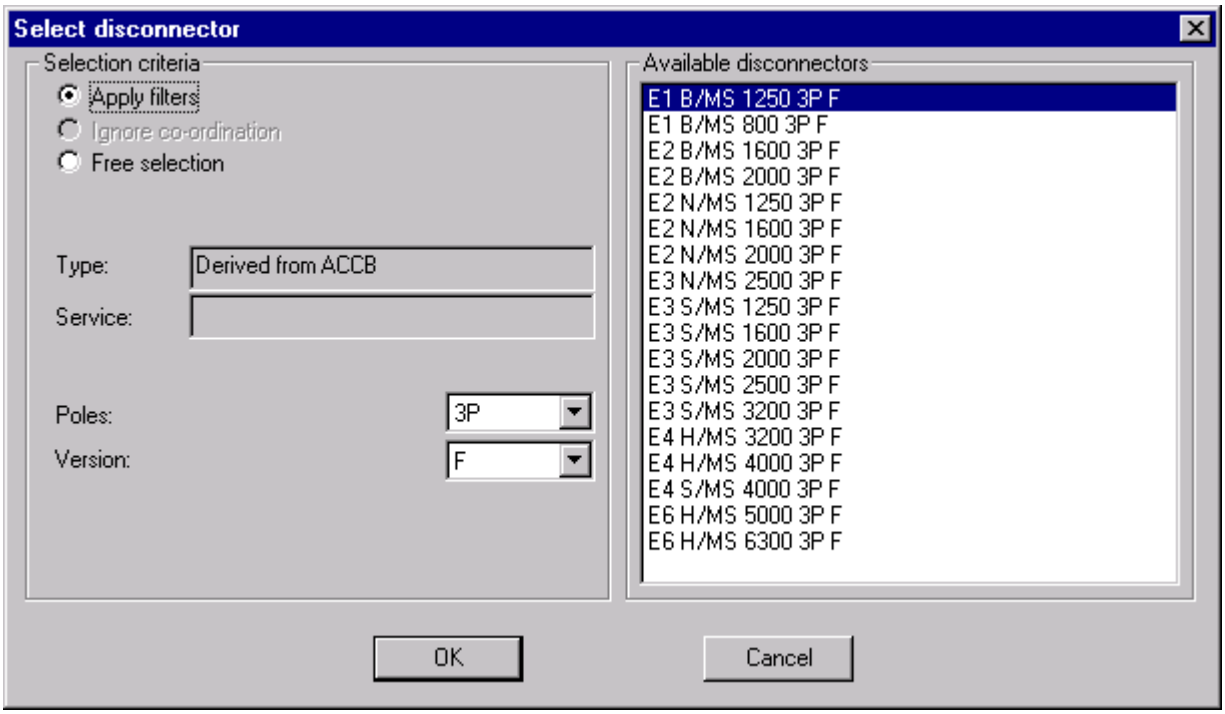


You can change the current disconnector, by pressing '*Select'*.
The choice of disconnector can be made by selecting one of the following three criteria in the top left part of the panel:
- *Apply filters*;
- *Ignore co-ordination*;
- *Free selection*.

If you select '*Apply filters',* DOCWin will display all disconnectors that satisfy the requirements set in the last phase, with the number of poles and version selected using the drop-down menus with the same names.
The abbreviations used for the versions mean:
- F: fixed disconnector
- P: plug-in disconnector
-W: withdrawable disconnector

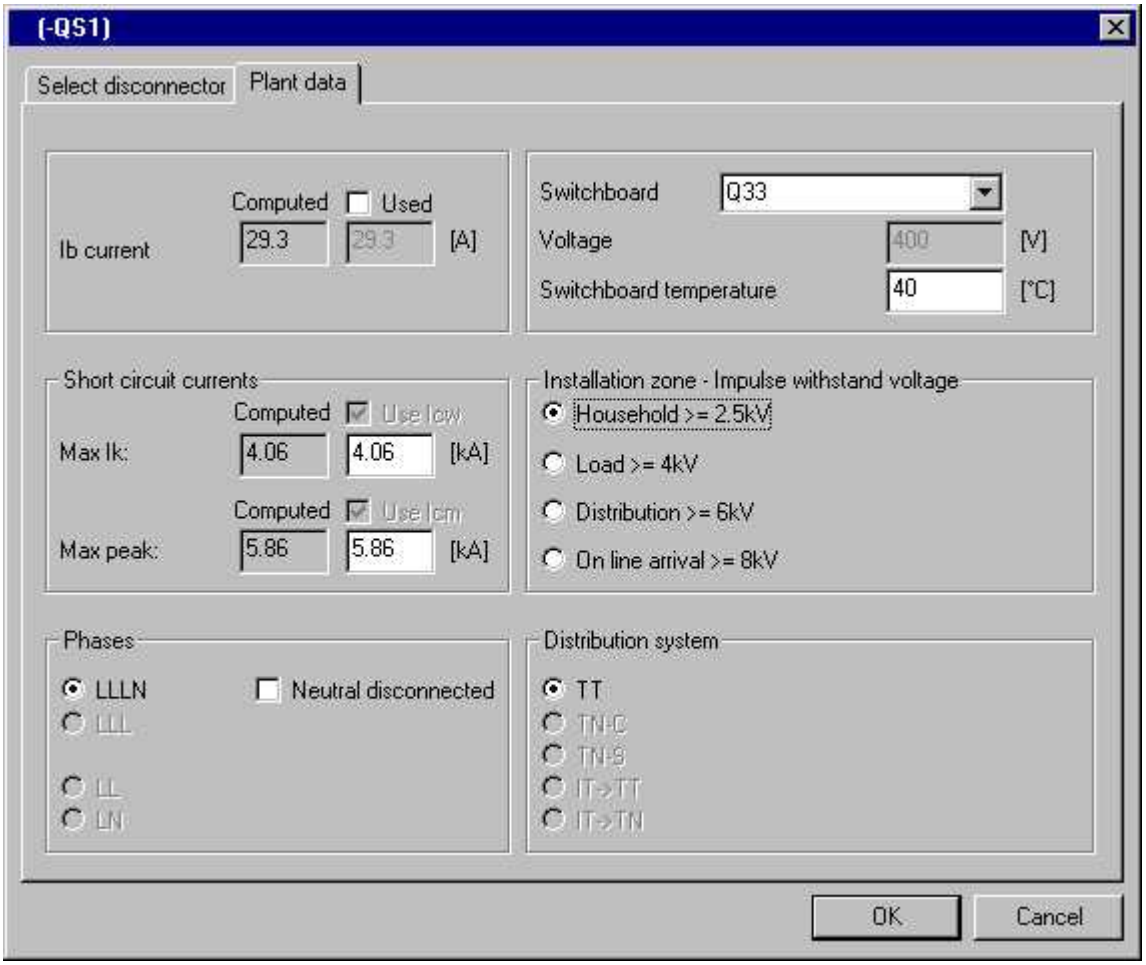
If you select '*Ignore co-ordination',* DOCWin will display disconnectors that satisfy the requirements set in the last operation only with regard to type of disconnector, type of service and with the number of poles and in the version selected from the drop-down menus with the same names.

If you select '*Free selection',* DOCWin will display all disconnectors available in the database compatible with the number of poles and version chosen.



Plant data

This panel is used to set data concerning the plant in which the disconnector is to be installed.



I_b current is the current which crosses the disconnector.
The box on the left displays the value calculated by DOCWin; select the *Used* box to enter the value desired (this option is useful when choosing a disconnector off-line).

The choice of disconnector can be made taking into consideration the values of the short-circuit current (effective value and peak value) calculated by DOCWin or by entering manually the value of the permitted short-circuit current I_{cw} and the short-circuit closing capacity I_{cm} (the latter is a peak value)

To make the right choice, you should also take into account the temperature of the switchboard in which the disconnector is situated.

The impulse withstand specified by the standards varies according to the installation zone

Set the number of phases (data which will be inherited from the network) and protection of neutral conductors.
If disconnection of neutral is permitted, the box *Neutral disconnected* will be enabled

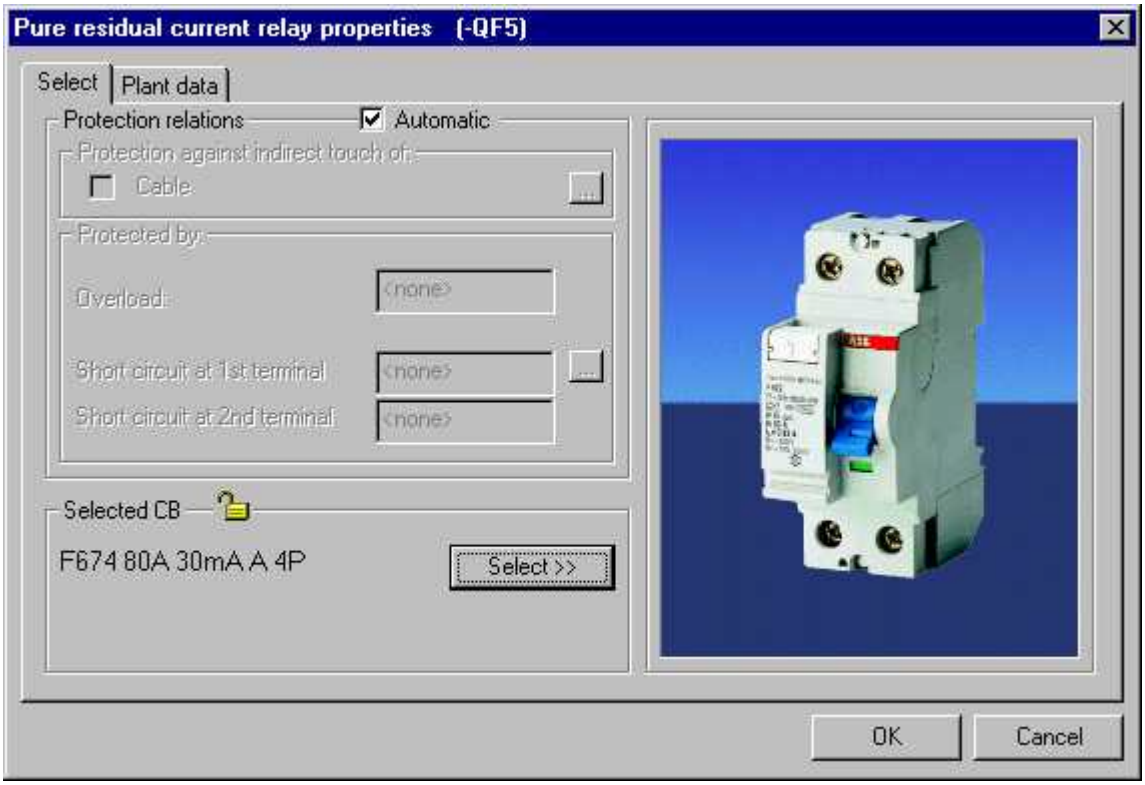
Distribution system data are inherited from the network, but they can be set.
If the TN-C distribution system is selected, the *Neutral disconnected* box is disabled. In this case the standards prohibit disconnection of the neutral conductor.

Finally, in the '*Selected disconnector'* box you can see which is the current disconnector, define its terminals and lock the choice if required, using the padlock.
In this mode, DOCWin will no longer be able to modify the choice of disconnector if it should have to redo calculations during the project refinement phase.
Nota bene

Keep a note of the objects that have been locked using the padlock. DOCWin will not modify the choice even if the objects should become unsuitable in the light of modifications made to the network after the disconnector has been locked.

PURE RESIDUAL CURRENT RELAY

The *Pure residual current relay properties* window has two panels:
- *'Select'*
- *'Plant data'*



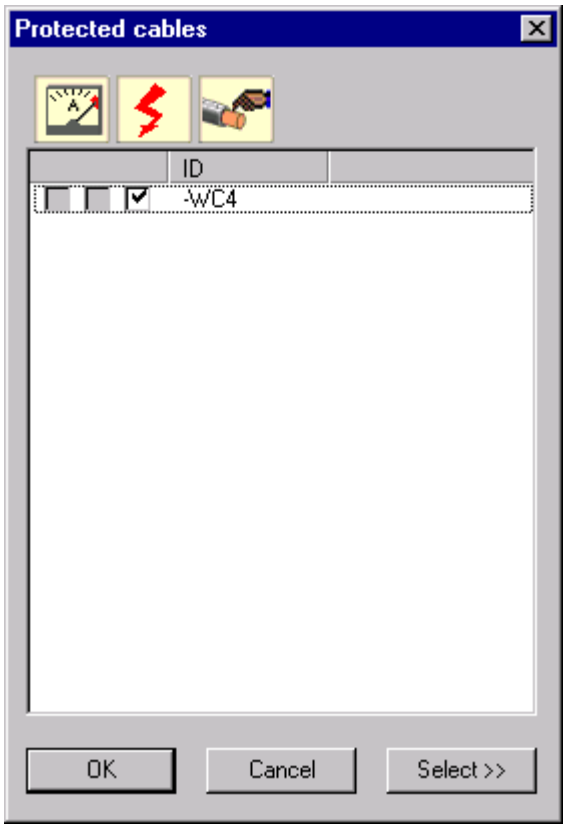
Selecting a pure residual current relay

This panel defines the features of the pure residual current relay, the protection device capable of protecting it against overcurrent (short-circuit and overload) and the devices protected against indirect contacts.

The pure residual current relay is able to protect cables against indirect contacts.

If you select '*Automatic',* DOCWin will automatically associate the pure residual current relay with the objects to be protected according to the following criteria:
- the circuit-breaker must be able to isolate the object to be protected against indirect contacts against *all* sources of supply (Utility and Generator).

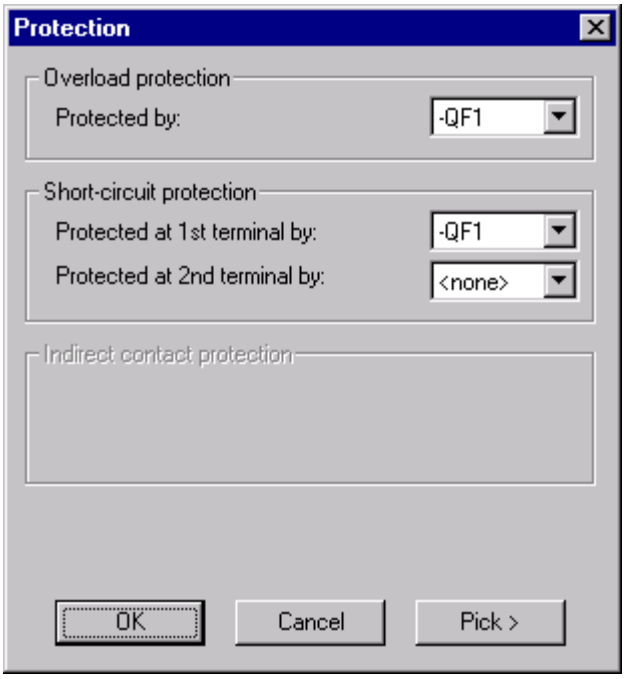
If you deselect *'Automatic'*, you will be able to press the button on the right of the category of objects to be protected, and manually select objects to be protected.



The '*Select'* command allows you to choose the cable to be protected directly on the schematic that has been drawn.

The '*Protected against short-circuit by'* box displays and sets the devices which are to protect the pure residual current relay from short-circuit and overload.

If you select '*Automatic',* DOCWin will choose the pure residual current relay, automatically co-ordinating it with the circuit-breaker immediately upstream (or with a number of circuit-breakers if the pure residual current relay is supplied from both sides)
If you deselect '*Automatic',* you can tell the program which circuit-breakers are protecting the pure residual current relay.

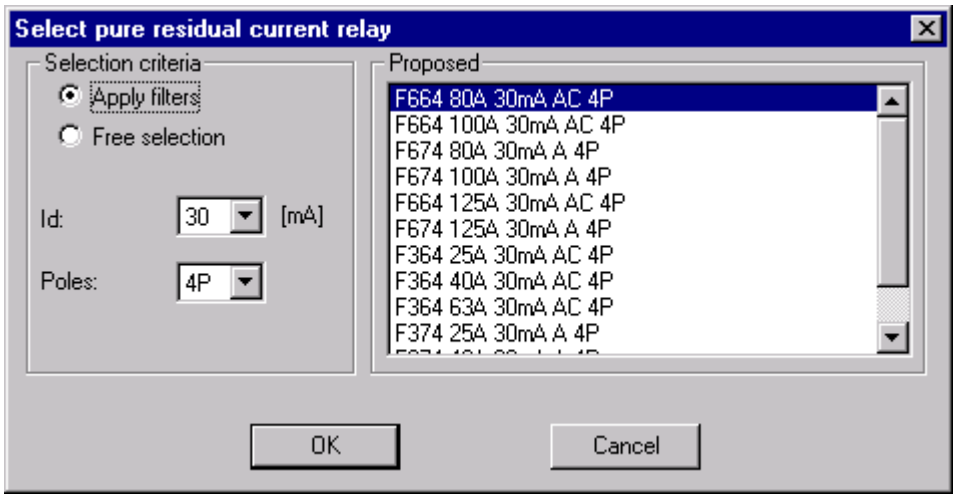


The 'S*elect'* button allows you to select circuit-breakers directly on the schematic that has been drawn.

The '*Selected CB'* panel displays the current pure residual current relay and locks the choice made with the padlock.
In this mode, DOCWin will no longer be able to modify the choice of pure residual current relay if it should become necessary to redo the calculations in the project refinement phase.

Nota bene
Keep a note of the objects that have been locked using the padlock. DOCWin will not modify the choice even if the objects become unsuitable in view of modifications made to the network after they have been locked.

The current pure residual current relay can be changed by pressing '*Select'*.



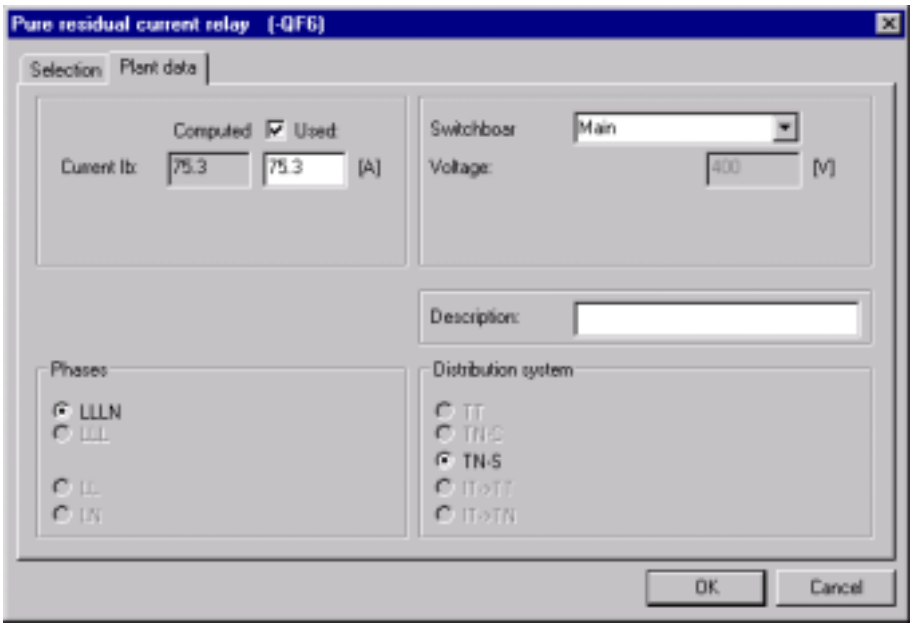
The choice of pure residual current relay can be made by selecting one of the two criteria in the top left part of the panel:
- *Apply filters*;
- *Free selection*.

If you choose '*Apply filters',* DOCWin will display all pure residual current relays that satisfy the requirements set in the last stage, with the number of poles and differential current chosen using the drop-down menus with those names.

If you choose '*Free selection',* DOCWin will display all pure residual current relays available in the database compatible with the number of poles and differential current chosen.

Plant data

This panel is used to set data concerning the plant in which the pure residual current relay is to be installed

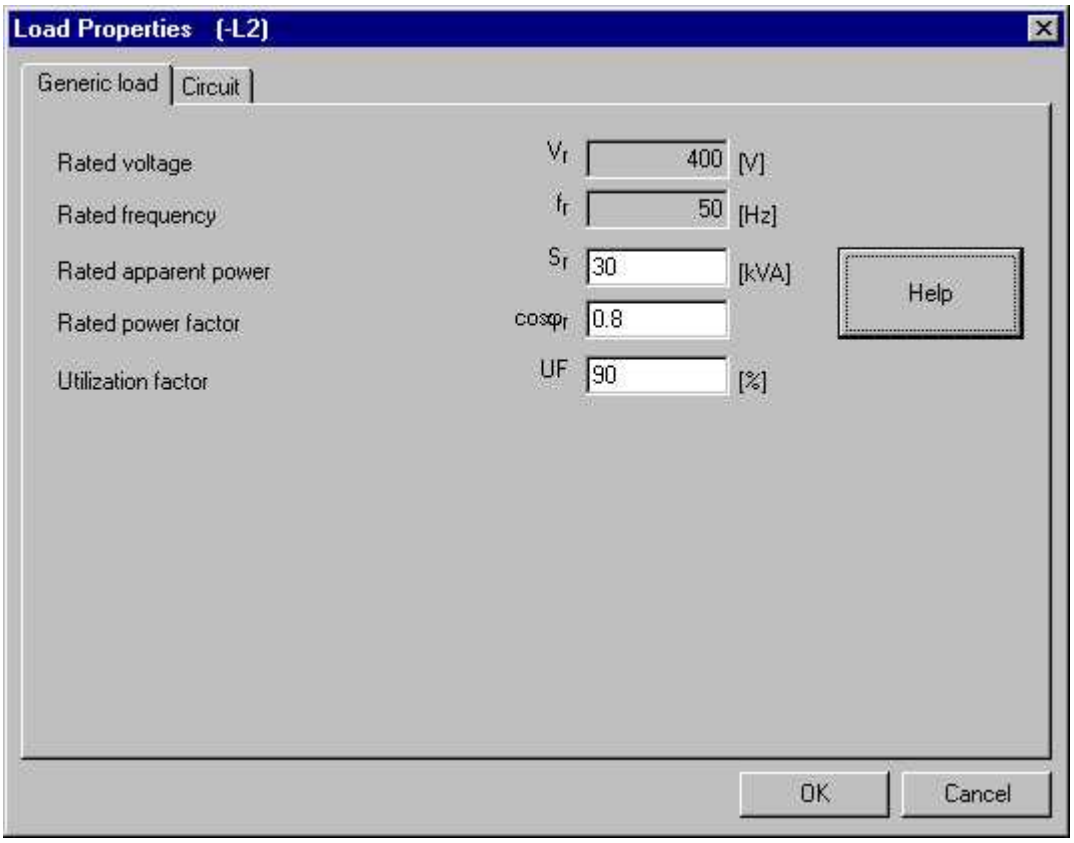


Current I_b is the current that crosses the pure residual current relay.
The box on the left displays the value calculated by DOCWin; if you select the '*Used*' box you can enter the desired value (this option is useful when choosing the pure residual current relay off-line).

You can enter the number of phases and distribution system. Data are inherited from the network, but can be modified.

GENERIC LOAD

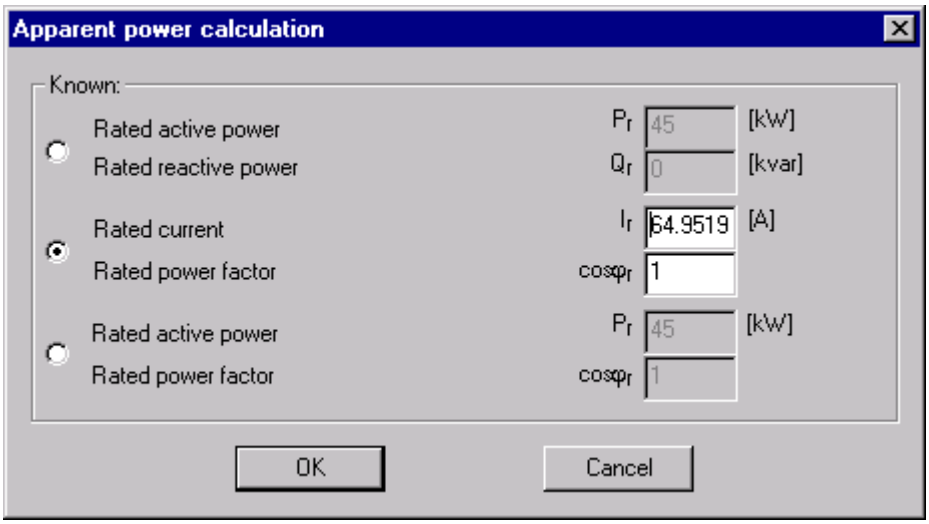
The '*Load properties'* window has two panels:
- *'Generic load'*
- *'Circuit'*



Generic load

This panel is where critical data concerning the load are entered:
- Rated voltage
- Rated frequency
- Rated apparent power
- Rated power factor
- Utilization factor

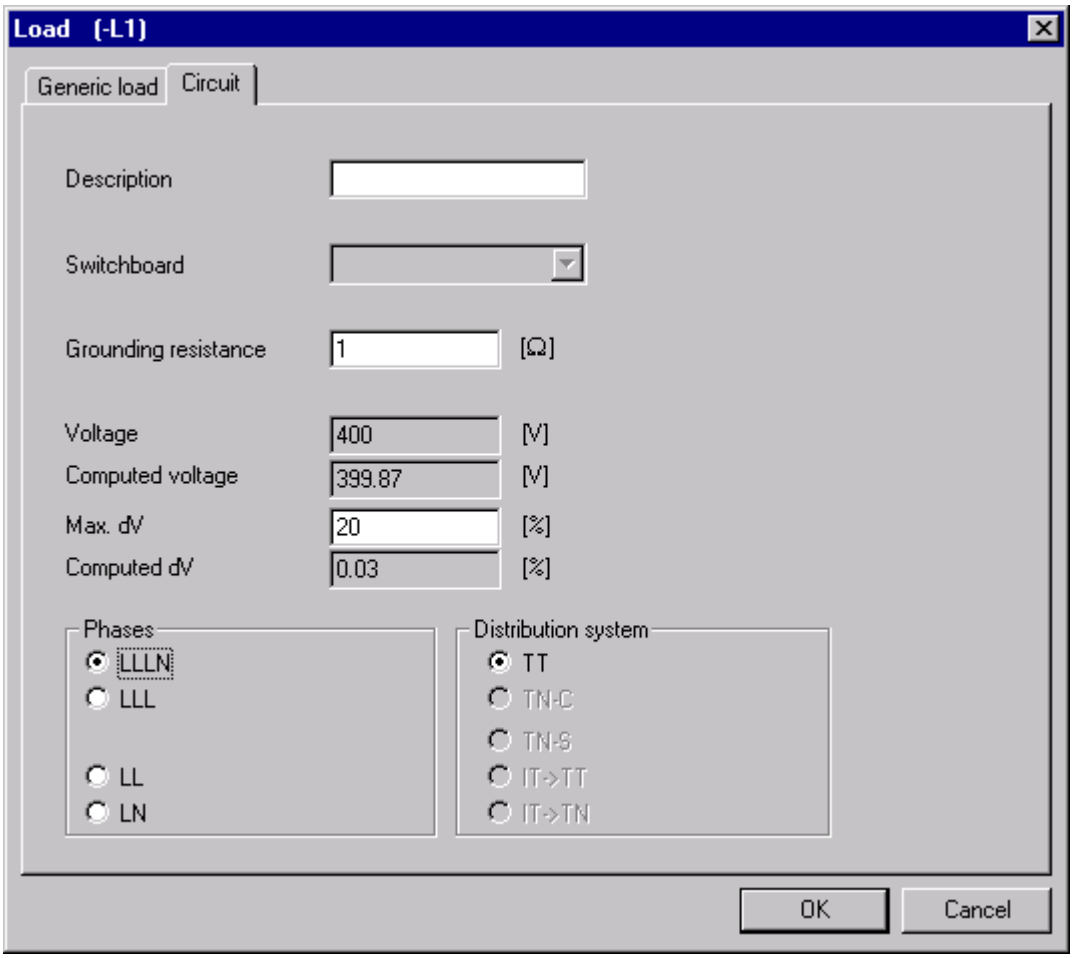
The rated voltage and frequency are inherited from the network, while the other values are entered by typing in the appropriate boxes.
A help button allows you to calculate known apparent power:
- Rated active power and rated reactive power
- Rated current and rated power factor
- Rated active power and rated power factor



Circuit

The circuit panel is used to modify the number of phases of the object or distribution system.

If appropriate, you can define the name of the switchboard in which the object and object grounding resistance are situated.



After the automatic calculations, the voltage and the calculated voltage drop are shown.
With regard to the distribution system and number of phases, remember that:

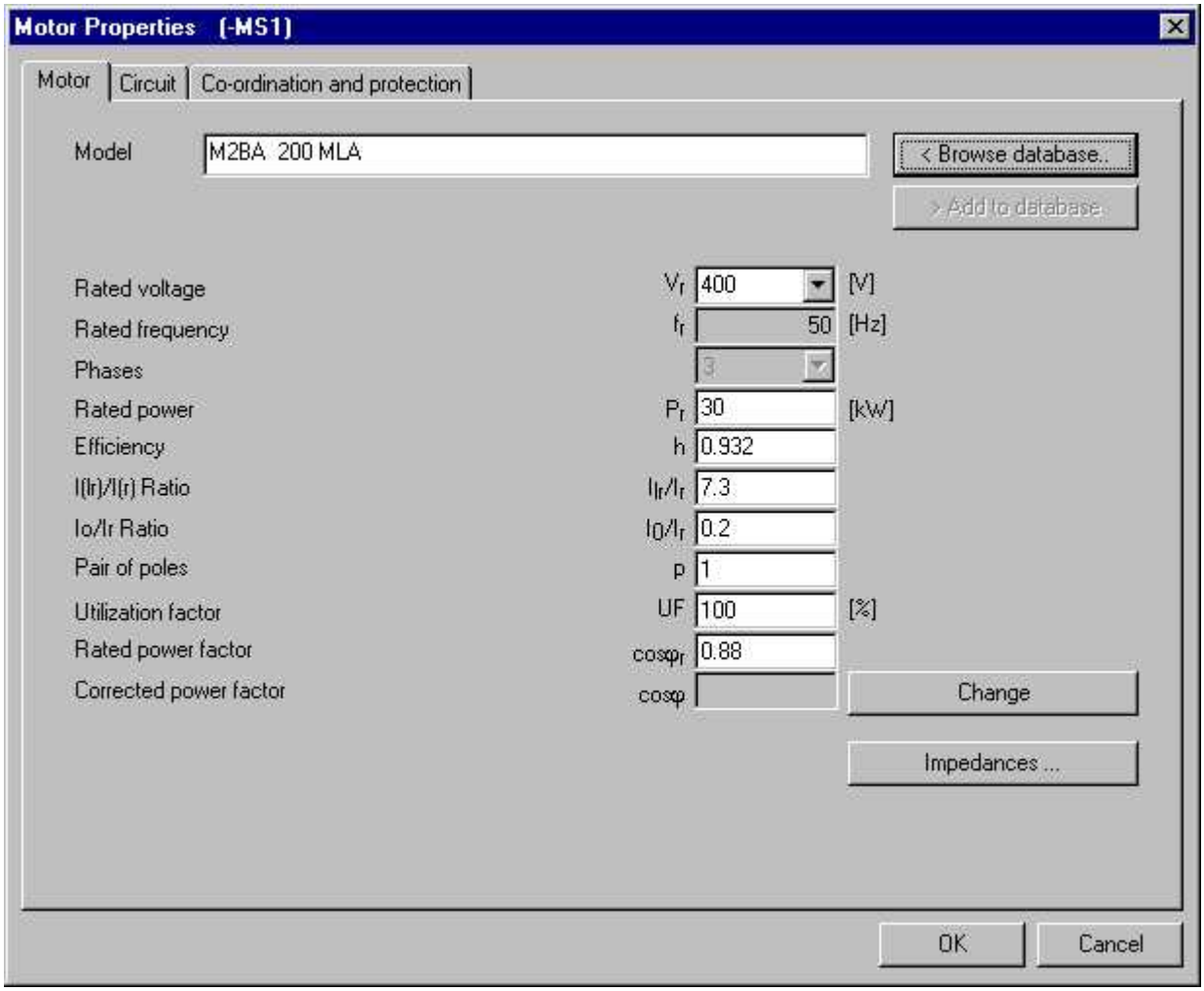
- when an object is drawn without being attached to another object, it will be possible to enter the distribution system and number of phases;
- if an object is drawn attached to another object present in the one-line diagram, it will inherit the distribution system and number of phases of the object already drawn.

MOTOR

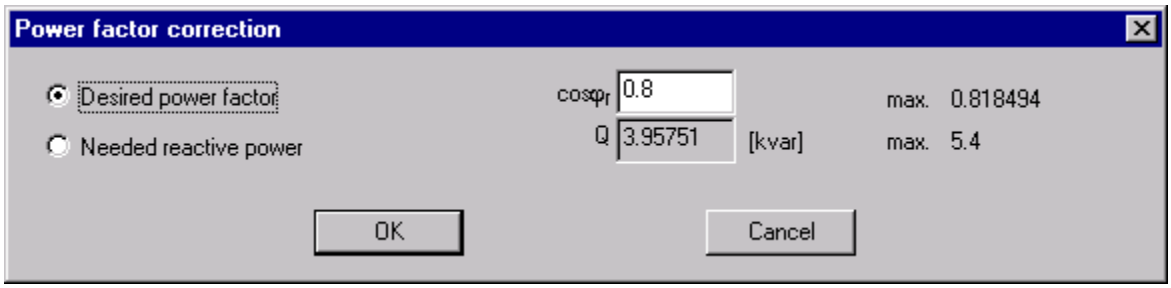
The motor interface allows you to insert data about a motor and to display the co-ordination and protection results.
The interface consists of three panels:
- *Motor*
- *Circuit*
- *Co-ordination and protection*

Motor

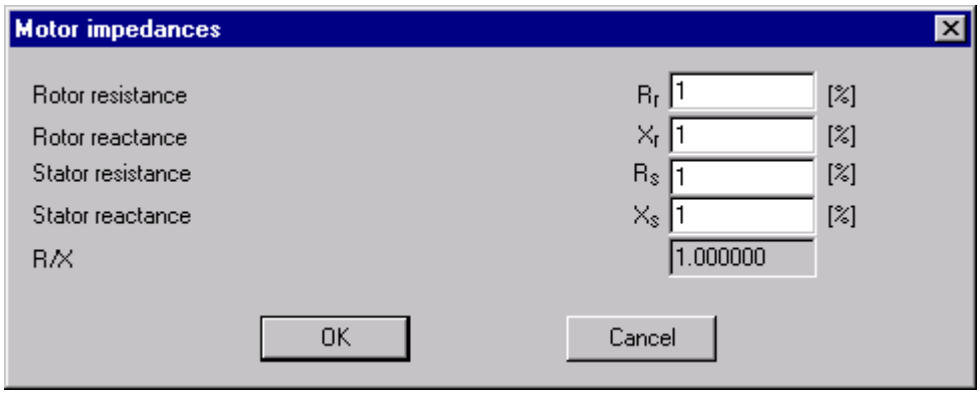
In this phase you enter properties of the motor:
- V_n rated voltage
- f_n rated frequency (this value is entered in the *General plant properties* window)
- number of phases (inserted automatically by DOCWin)
- P_n rated power
- h efficiency
- I_{lr}/i_n ratio between locked rotor current and rated current
- I0/In ratio between no-load current and rated current
- pair of poles
- UF utilization factor
- $\cos\varphi_n$ rated power factor
- $\cos\varphi$ corrected power factor



The '*Change'* command brings up a window where you can calculate the reactive power required to obtain a determined power factor, or conversely to calculate the power factor when the installed reactive power is known.

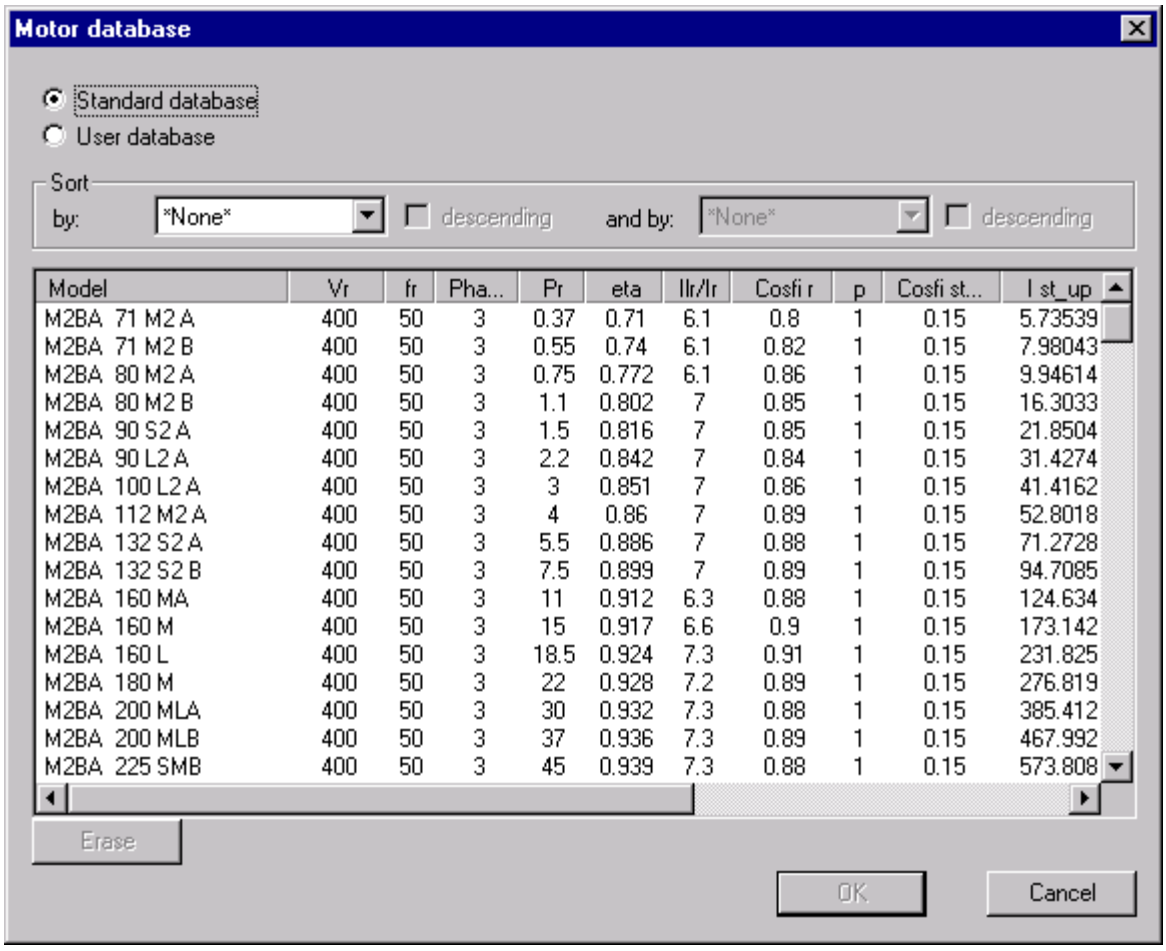


The '*Impedances'* button allows you to modify the values for rotor resistance and reactance and values for stator resistance and reactance (values are expressed as a percentage)



The '*Browse database'* and '*Save to database'* commands make it easier to enter data; DOCWin has two databases from which data about the motor can be extracted, i.e. a *'Standard database'* containing data about ABB production motors and a *'User database'* which can be created by you. To enter data about a motor into the user database, complete all fields (including *Model*) and use the '*Save to database'* command. The '*standard database'* is not modifiable

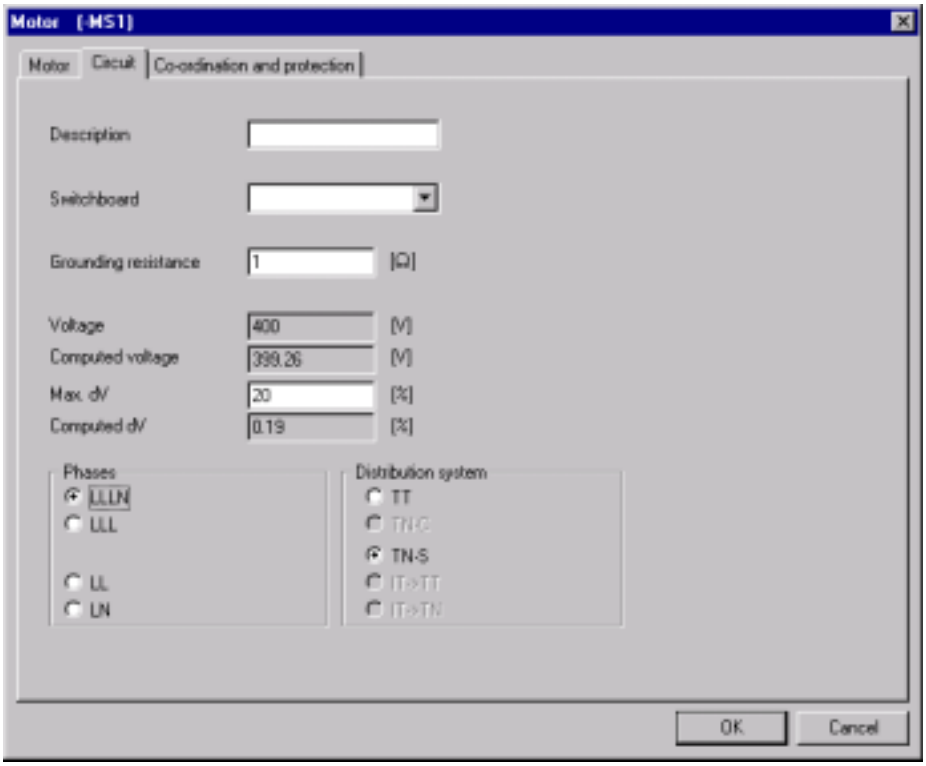
The '*Browse database'* command brings up the '*Motor database'* window, in which you can browse both the user and standard databases to choose motor features. Use the '*Sort'* and '*Erase'* commands to manage both databases.



Circuit

The circuit panel is used to modify the number of phases of the object or distribution system.

If appropriate, you can define the name of the switchboard in which the object and object grounding resistance are situated.

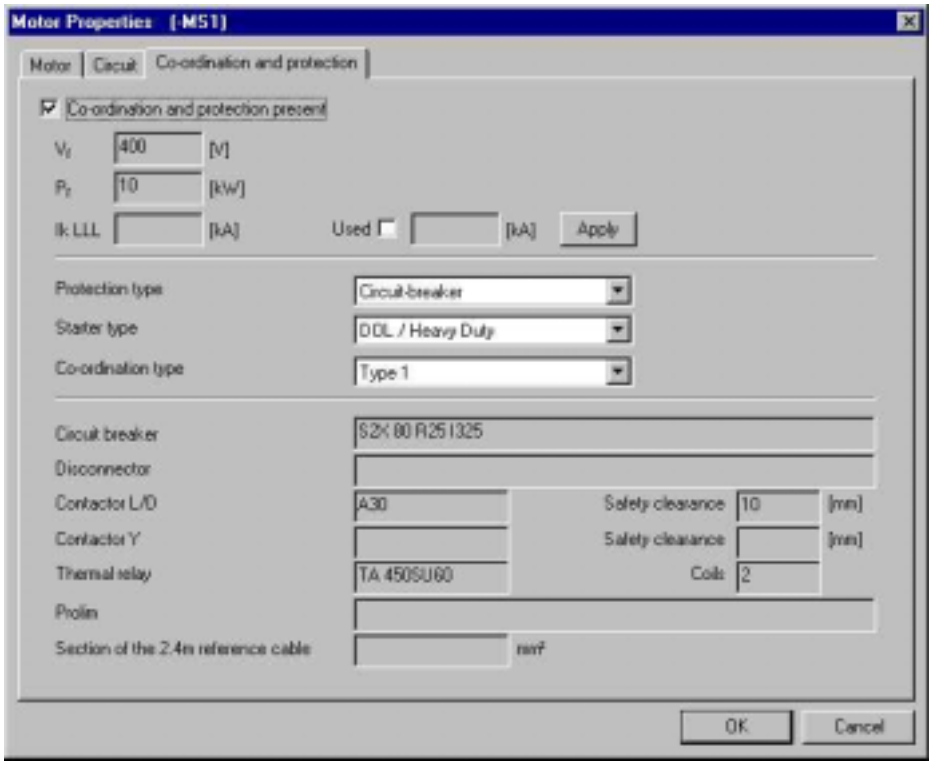


After the automatic calculations, the voltage and the calculated voltage drop are shown.
With regard to the distribution system and number of phases, remember that:

- when an object is drawn without being attached to another object, it will be possible to enter the distribution system and number of phases;
- if an object is drawn attached to another object present in the one-line diagram, it will inherit the distribution system and number of phases of the object already drawn.

Co-ordination and protection

This panel displays the components required for operation and protection of the motor.

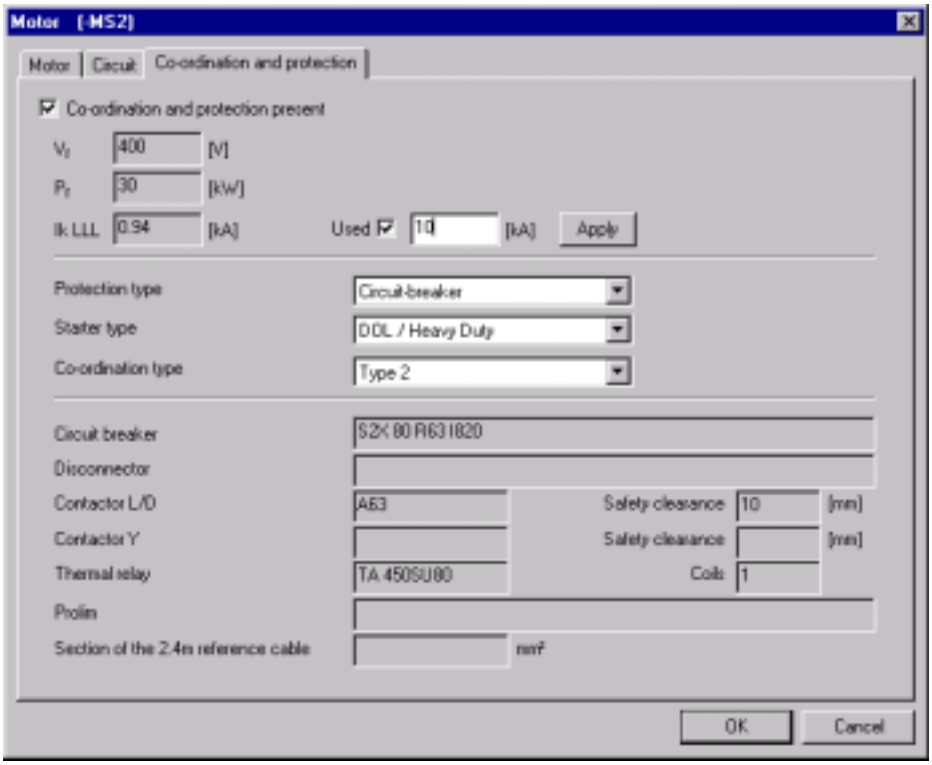


DOCWin allows you to dimension the starter (see 2.2.15 CEI EN 60947-1), i.e. all switching devices required to start and stop a motor, in combination with appropriate overload protection.

The starter proposed by the program is a DOL (Direct On Line) or Star/Delta protected or combined (see 2.2.8 CEI EN 60947-4-1) starter.
The following data are required to define the starter correctly:

- Rated voltage;
- Motor power;
- Short-circuit current;
- Starter type
- Co-ordination type
- Device type

The rated system voltage Ue for switchgear (4.3.1.1 IEC 60947-1) is the voltage value which, together with the rated system current, defines the use of the system itself and to which applicable tests and category of use refer. In this case, the reference value is the voltage between the phases.
Voltage and power values are inherited from the '*Motor'* panel.
The short-circuit current to be considered can be the one calculated by DOCWin or you can select *Used* and enter it in the appropriate box. The '*Apply'* command enables changes that have been made.



Protection type, starter type and co-ordination type are chosen from the drop-down menus with the same names.

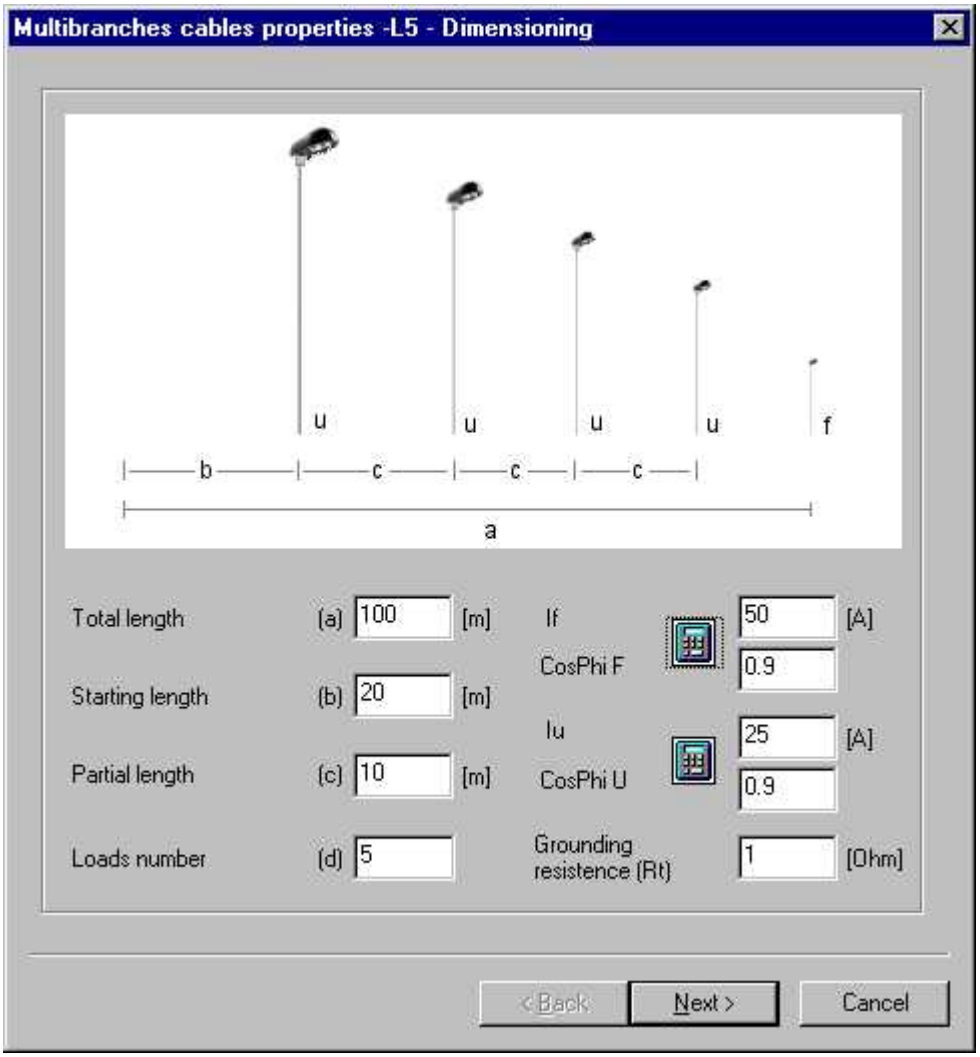
A DOL starter system is able to start and accelerate the motor at normal speed, protect it from overload and disconnect the supply when necessary. The type of service affects the properties of thermal release (in particular, the “trip class"); for example, normal starts require a type 10 or 10A trip class, while particularly heavy starts require type 20 or 30 trip class.
In TYPE 1 co-ordination, the contactor or starter subject to short-circuit current is not obliged to ensure continuity of service until it has undergone maintenance or damaged parts have been replaced.
In TYPE 2 co-ordination, the contactor must not be damaged in any way, except for welding the contacts which is acceptable if the contacts can be easily separated (e.g. by a screwdriver or if the contact can easily be replaced.
The lower part of the panel displays the co-ordination results based on data entered during the previous operation.

The '*Safety clearance'* is the minimum distance of the contactor from the sides of the case.
'Coils' is the number of turns that the supply conductors have to wind on the primary winding of the thermal relay transformer.
'Prolim' is a device that reduces short-circuit current.
The standard CEI EN 60947-4 permits a maximum length of 2.4 metres for connecting the starter to the circuit; DOCWin provides the cross-section for this cable.

MULTIBRANCH CABLE

Multibranch cable allow you to model distributed loads very conveniently with uniform power drawn for the whole length (typically the case for lighting circuits).
Dimensioning is no different from dimensioning of normal cable (see Cable section). However, the program needs to be supplied with a set of additional information for the cable, relating to the geometry of the object.
In particular, with reference to the following figure, you need to enter:

- Total length of conductor (a);
- Length of the initial section of conductor before the first branch (b);
- Length of intermediate sections between two branches (which are all equal to each other) (c);
- Number of intermediate branches (d);
- Current required by the last branch (If);
- Power factor of the last branch (cosφF);
- Current required by intermediate branches (same for all branches) (IU);
- Power factor for intermediate branches (same for all branches) (cosφU);
- Grounding resistance (only if distribution system is TT)



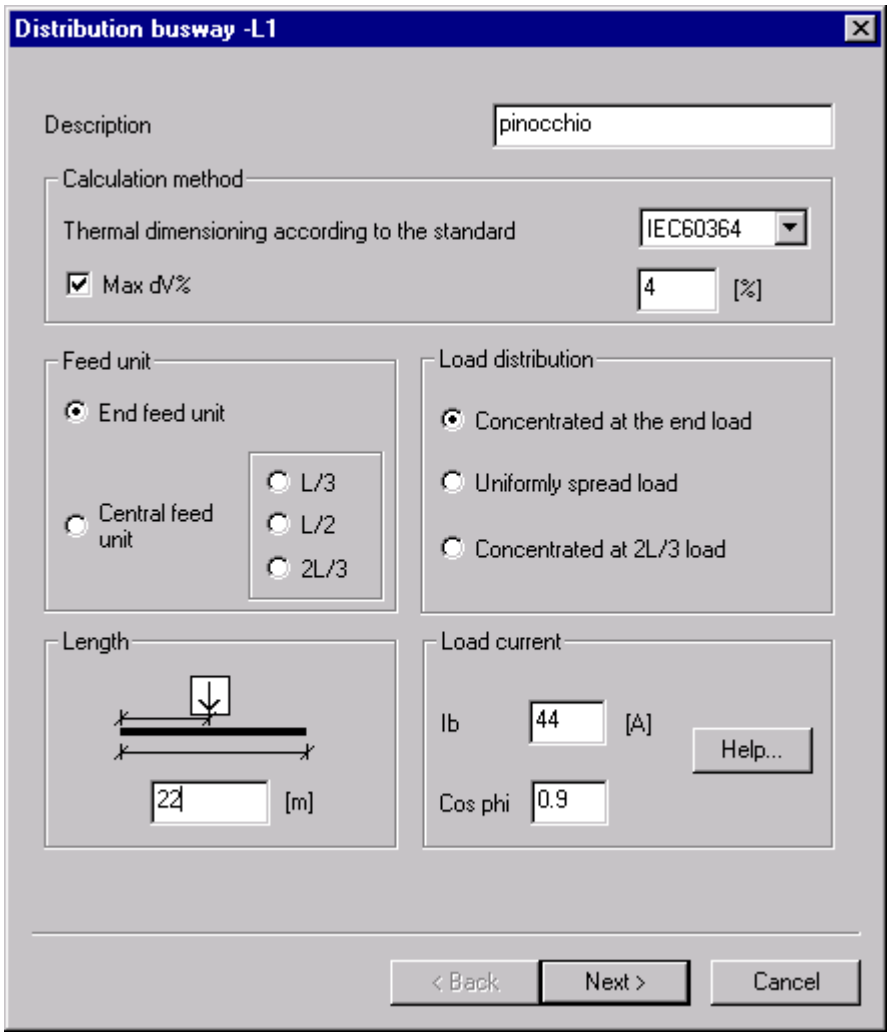
To make it easier to enter data, use the buttons with calculator icons to access an interface.

The program uses these data to calculate the length of the final section before the last branch, and can then continue with dimensioning. The multibranch cable is dimensioned with a uniform cross-section and the voltage drop is calculated taking the successive current taps into account.

DISTRIBUTION BUSWAY

The distribution busway describes distributed loads supplyed by a busbar trunking system.
The calculation method is not different from the one used for busway. However is necessary to specify some further data.
In particular, with reference to the figure below, the necessary data are:

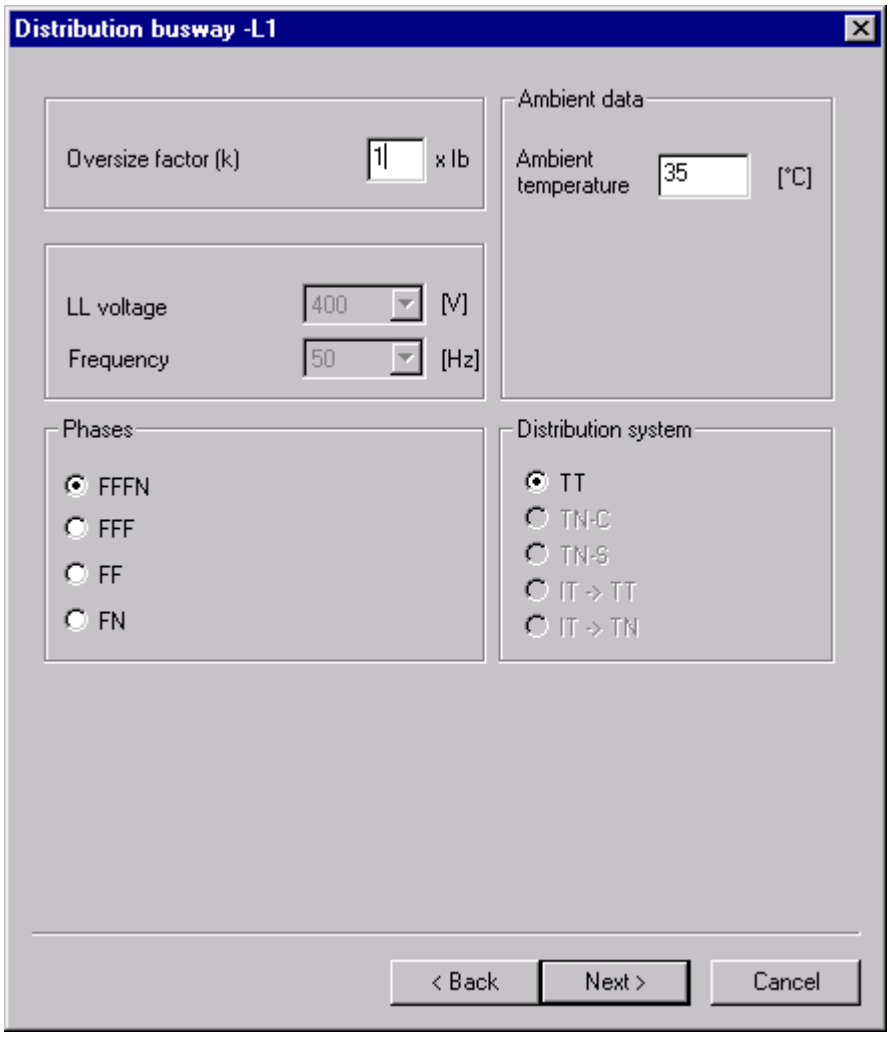
- the total lenght L;
- the position of the feed unit: at the end of the distribution busway, at L/3, at L/2 or at 2L/3;
- the position of the load ('*Concentrated at the end load*', '*Uniformly spread load*'; '*Concentrated at 2L/3 load* ');
- the load current and the power factor; the button '*Help*' allows to insert data in the most convenient way.



Click on '*Next*' to insert:

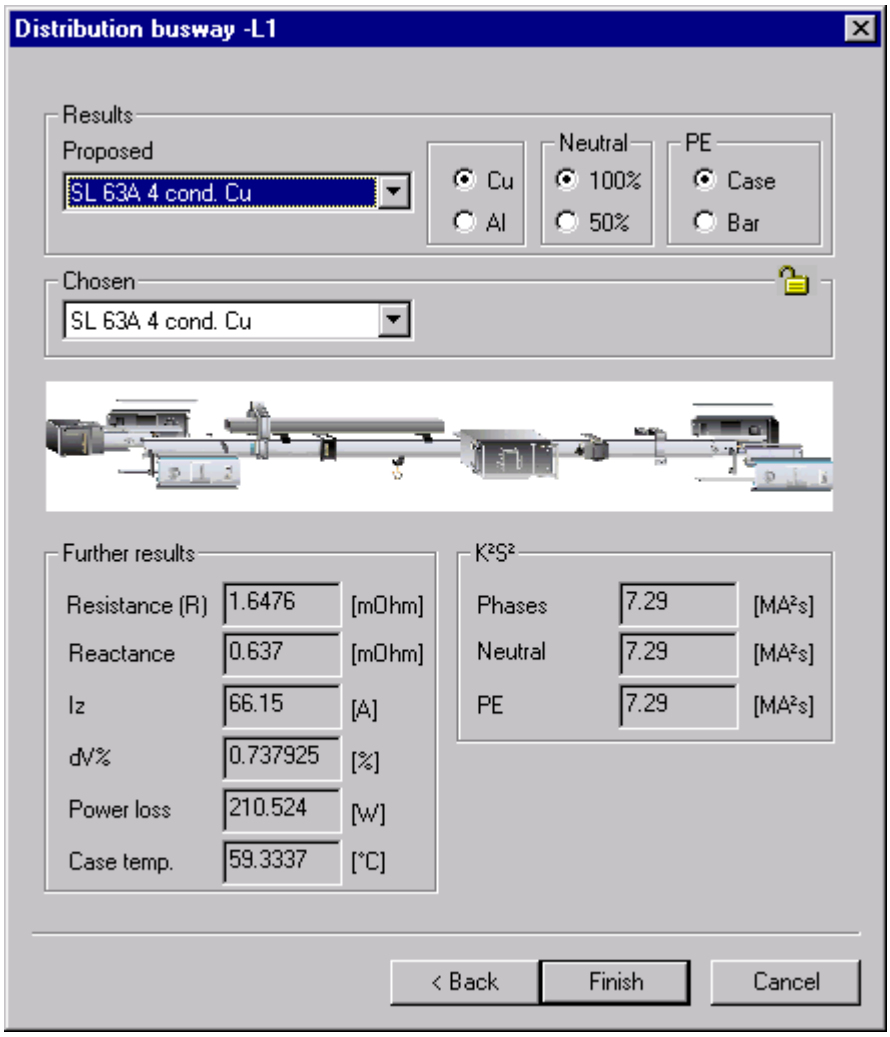
- the '*Oversize factor*': use this factor to force the inserted load current.
- the '*Ambient temperature*': according to the CEI EN 60439-2 standard, the carrying capacity is given by the manufacturer at the ambient temperature of 35°C. For different temperatures, a correction factor given by the manufacturer is applied to correct the carrying capacity.

Data related to the circuit ('*Phases*' and '*Distribution system*'), are inherited from the net. If necessary, they can be changed connecting the distribution busway directly to a busbar.



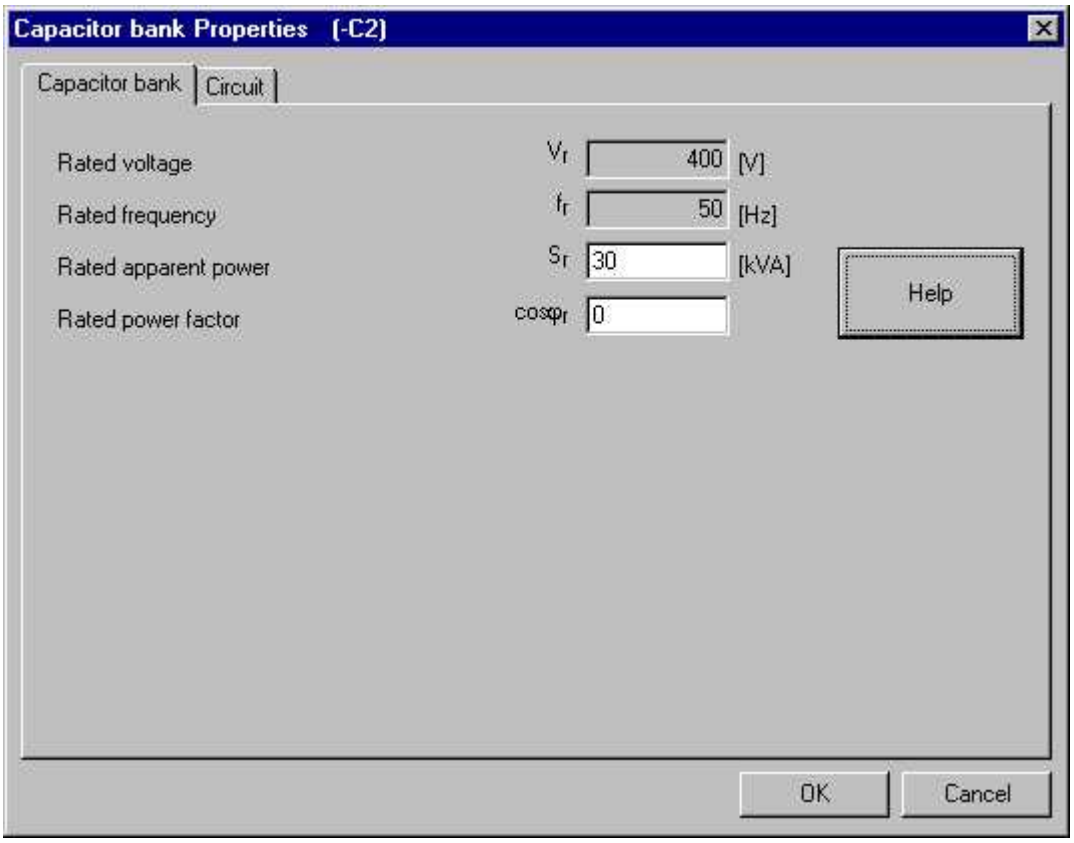
Click on'*Next*' to read the results. DOCWin proposes all the valid busway ordered by price. The user can choose filtering the proposed solutions according by:
- conductive material (Cu or Al);
- cross-section of the neutral conductor (50% or 100% of the cross-section of the phases conductors);
- the type of PE conductor (Case or Bar).

In the lower part of the window are shown further results:
- resistance and reactance;
- carrying capacity;
- voltage drop;
- losses;
- case working temperature;
- specific energy of phases, neutral and PE.


Distribution busway -L1
Results
Proposed
SL 63A 4 cond. Cu
Cu
Al
Neutral
100%
50%
PE
Case
Bar
Chosen
SL 63A 4 cond. Cu
Further results
Resistance (R)
1.6476
[mOhm]
Reactance
0.637
[mOhm]
Iz
66.15
[A]
dV%
0.737925
[%]
Power loss
210.524
[W]
Case temp.
59.3337
[°C]
K²S²
Phases
7.29
[MA²s]
Neutral
7.29
[MA²s]
PE
7.29
[MA²s]
< Back
Finish
Cancel

CAPACITOR BANK

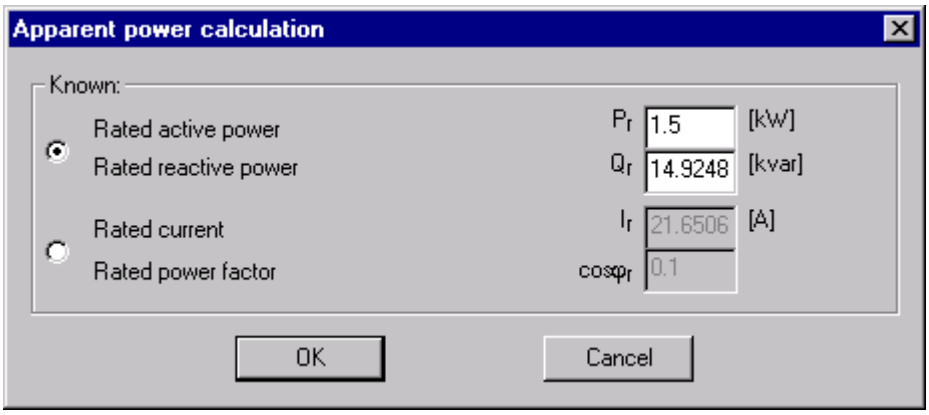
The '*Capacitor bank properties'* window has two panels:
- *'Capacitor bank'*
- *'Circuit'*



Capacitor bank

This panel is used to enter important data about a capacitor bank:
- Rated voltage
- Rated frequency
- Rated apparent power
- Rated power factor

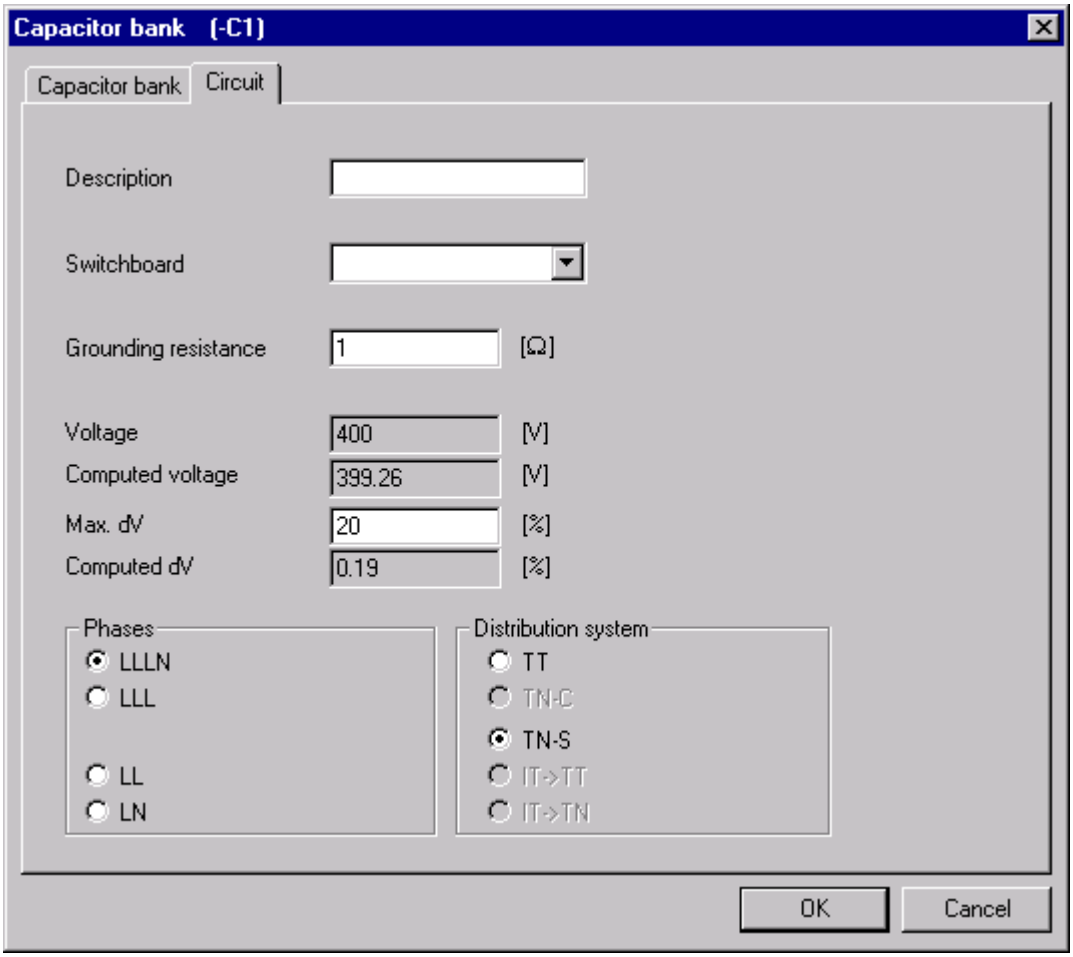
Rated voltage and frequency are inherited from the network while the other values are entered by typing them in the appropriate boxes.
A help button allows you to calculate known apparent power:
- Rated active power and rated reactive power
- rated current and rated power factor



Circuit

The circuit panel is used to modify the number of phases of the object or distribution system.

If appropriate, you can define the name of the switchboard in which the object and object grounding resistance are situated.

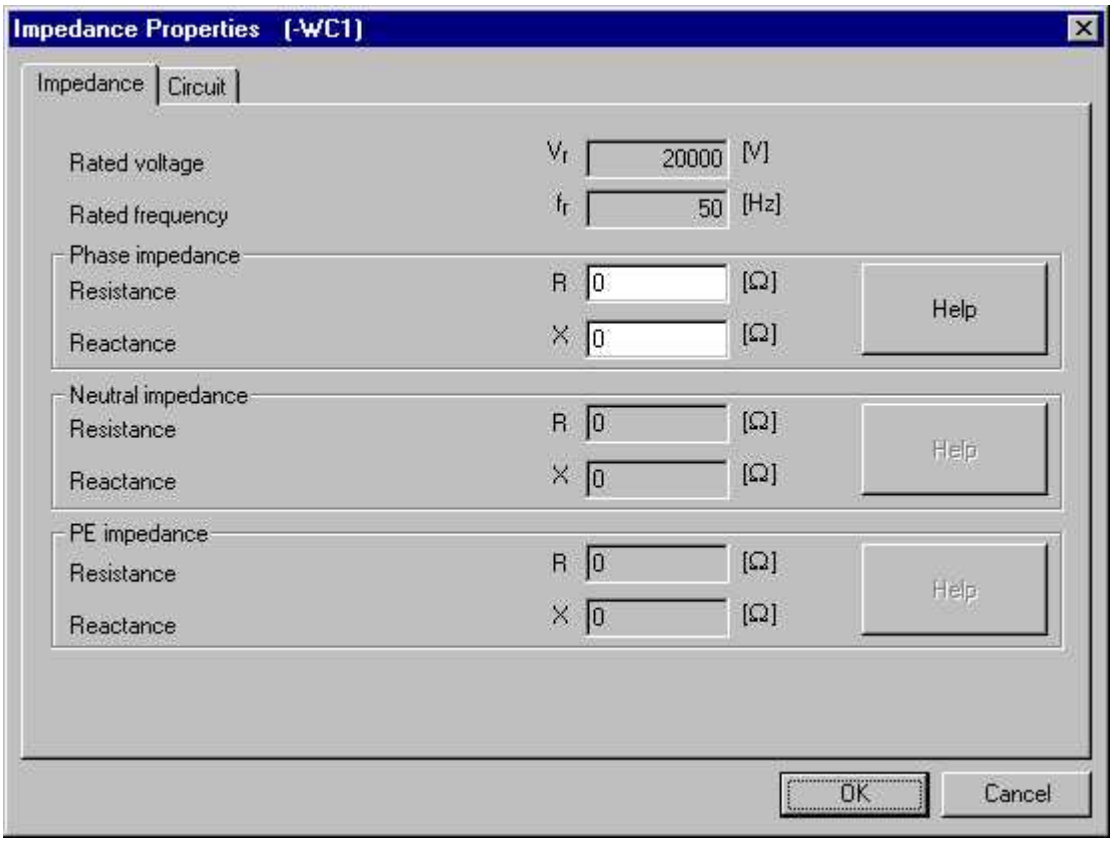


After the automatic calculations, the voltage and the calculated voltage drop are shown.
With regard to the distribution system and number of phases, remember that:

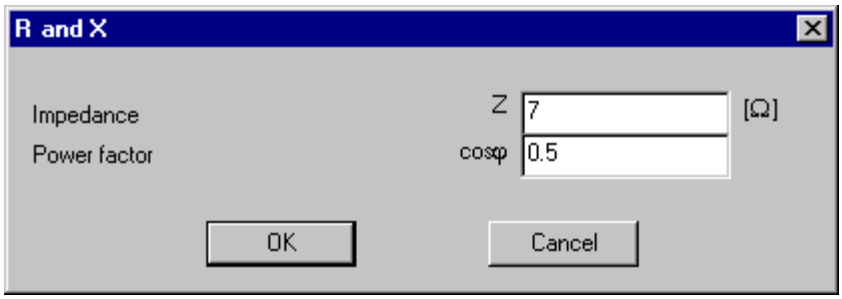
- when an object is drawn without being attached to another object, it will be possible to enter the distribution system and number of phases;
- if an object is drawn attached to another object present in the one-line diagram, it will inherit the distribution system and number of phases of the object already drawn.

MV CABLE

DOCWin does not dimension medium voltage cable, but takes it into account when calculating short-circuit and Load-flow, by importing its impedance value.
Select the medium voltage cable and then press Properties to display a window which is similar to the generic impedance window.



Use a '*Help*' button to obtain values for resistance and known resistance, as well as impedance and power factor.



The '*Circuit*' panel inherits the values for voltage, distribution system and number of phases from the general plant properties. DOCWin manages all low voltage distribution systems and number of phases, while for medium voltage it manages only a three-phase distribution system and IT isolated neutral.

MV CIRCUIT-BREAKER

DOCWin does not dimension MV circuit-breakers, and displays the *MV circuit-breaker* object only for graphical purposes.

MV DISCONNECTOR

DOCWin does not dimension MV disconnectors, and shows the *MV disconnector* object only for graphical purposes.

MV FUSE

DOCWin does not dimension MV fuses, and shows the *MV Fuse* object only for graphical purposes.

OBJECT PROPERTIES

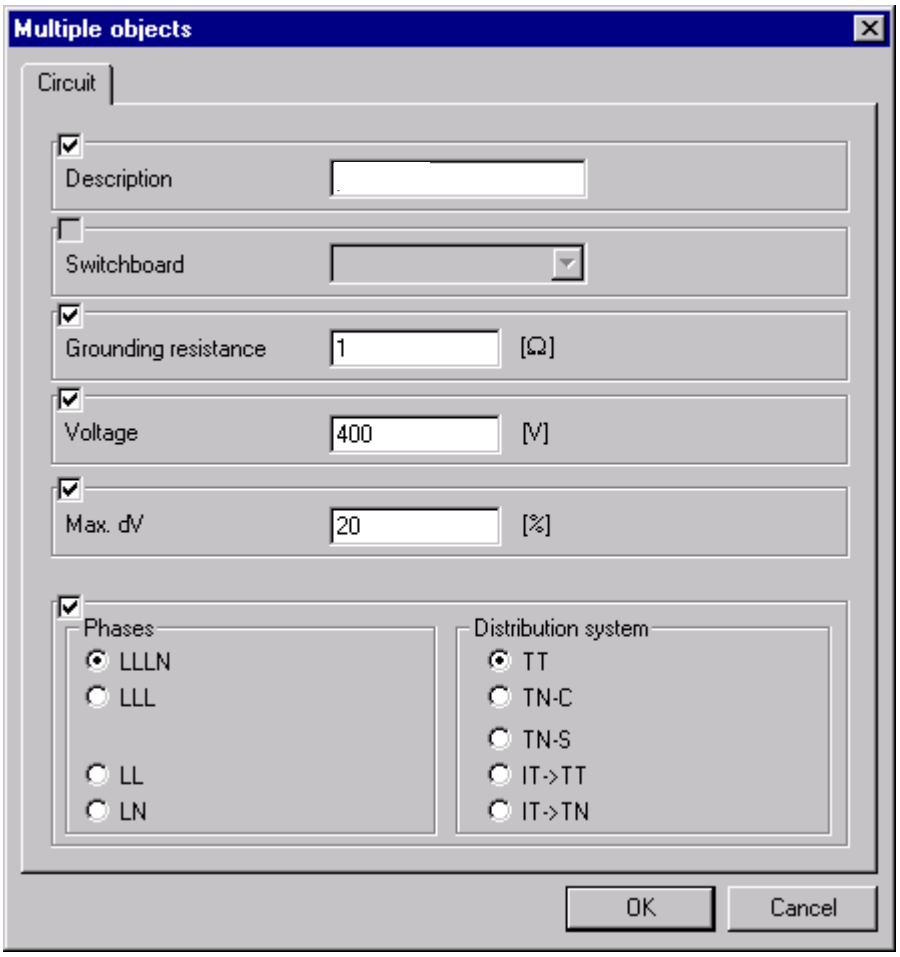
PROPERTIES command

The Properties command allows you to interact with the objects that make up the electrical schematic displayed by modifying values, parameters and settings relating to the object selected.
Initiate the command and select the object or double-click the object whose properties you want to display.

Modifying the properties of several objects at the same time

DOCWin allows you to change properties common to several objects simultaneously.

Select the objects and press '*Properties'*. This will bring up the '*Multiple objects properties'* window:



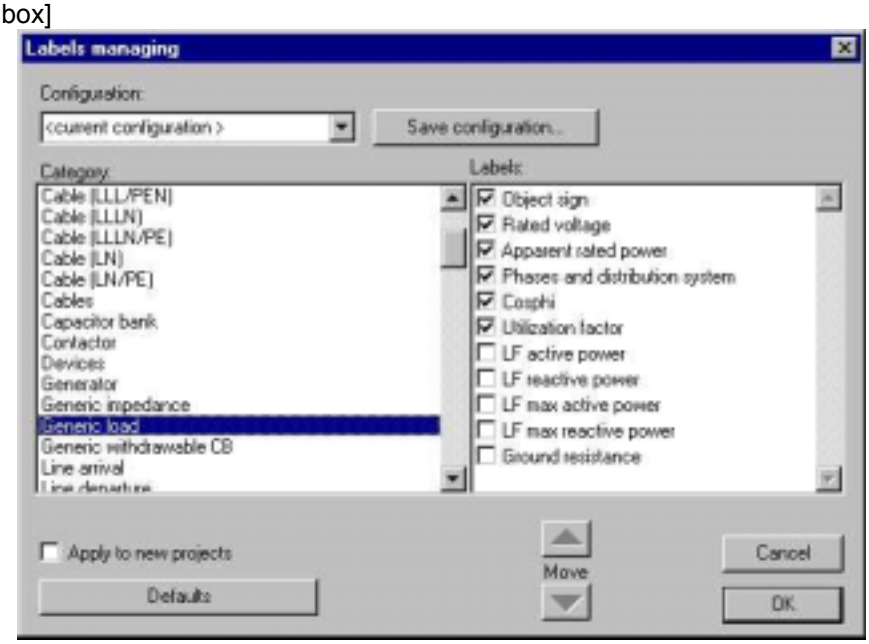
If you check the box on the corner of the '*Phases'* and '*Distribution system'* area, you can enter the number of phases.
Confirm with '*OK'*. This choice will affect all the objects selected
You can modify other properties of various objects in the same way.

SETTING OF OBJECTS DATA

SETTINGS menu: Settings of objects data

The '*Settings of objects data'* command is used to determine which labels to display in the project next to the symbols relating to objects; the command also allows you to enter the order in which these labels are displayed
You can save a number of user-defined configurations.

In the appropriate box, type the name to be given to the current configuration and click on the '*Save configuration*' box]



When enabled, the '*Apply to new projects*' option you to save current settings so that they can be used again in new projects.
These buttons allow you to move labels up or down to create a display hierarchy.

CALCULATION OF SHORT-CIRCUIT CURRENT

DOCWin calculates maximum and minimum short-circuit circuits in accordance with:
- The symmetrical components method
- Standard IEC 60909-1
- Standard IEC 61363-1

SYMMETRICAL COMPONENTS METHOD

The symmetrical components method is used to calculate three-phase, two-phase and short-circuit current. In three-phase networks, short-circuit currents for asymmetrical faults are calculated using symmetrical component algebra; the calculation is based on analysis of three independent circuits, each with its own impedance, without mutual coupling. With this method, the currents in each phase are obtained by superimposition of the currents of the three symmetrical component systems, positive phase-sequence system, negative-phase sequence system and zero-phase sequence system.
The symmetrical components method is used to calculate the value of the symmetrical short-circuit current (which varies over time) and maximum peak value.

STANDARD IEC 60909-1.

Standard IEC 60909-1 applies to calculation of short-circuit currents:
- In three-phase alternating current (AC) low and medium voltage networks;
- In three-phase alternating current networks with rated voltage up to 380 kV and frequency of 50 Hz or 60 Hz.

The calculation is based on the following assumptions:
- the structure of the network is not modified throughout the duration of the short-circuit;
- arc resistance is not taken into account;
- the contribution of three-phase motors is taken into account under the appropriate hypothesis;
- the contribution of single-phase motors is not taken into account;
- state before the fault is not taken into account;

The standard provides the procedure for calculating maximum and minimum values for the following parameters:
- $\mathbf{I''_k}$ initial symmetrical short-circuit current;
- $\mathbf{i_p}$ peak short-circuit current;
- $\mathbf{i_b}$ symmetrical short-circuit breaking current;
- $\mathbf{i_{dc}}$ aperiodic components of the short-circuit current;
- $\mathbf{I_{basym}}$ asymmetrical short-circuit breaking current;
- $\mathbf{I_k}$ steady-state short-circuit current.

i_b I_{basym} i_{dc} vary over time and DOCWin allows you to calculate them at four separate timepoints.

STANDARD IEC 61363-1

The standard IEC 61363-1 applies to calculation of short-circuit currents in shipboard installations and fixed or moving marine platforms with exclusively radial networks.
The calculation assumes the following hypotheses:
- state before the fault is taken into account
- calculation of three-phase short-circuit current only is taken into account

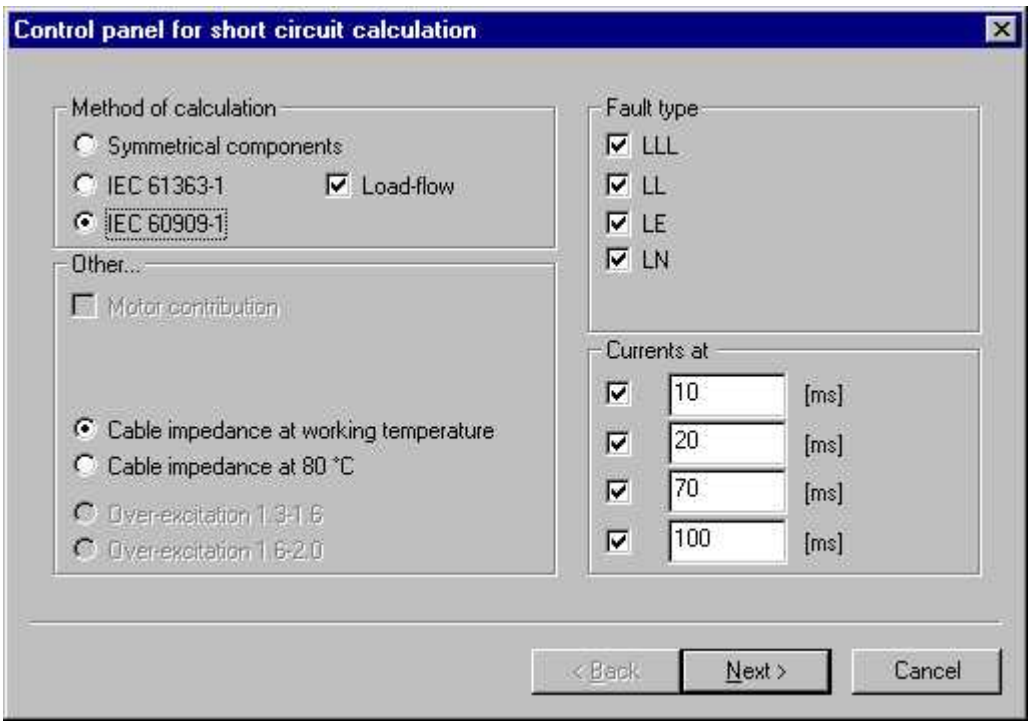
The standard provides the procedure for calculating the following values:
- $\mathbf{I''_k}$ initial symmetrical short-circuit current;
- $\mathbf{i_p}$ peak short-circuit current;
- $\mathbf{I_{ac}}$ symmetrical component of the short-circuit current;
- $\mathbf{i_{dc}}$ aperiodic components of the short-circuit current;
- $\mathbf{I_k(t)}$ upper envelope of the time dependent short-circuit current
- $\mathbf{I_k}$ steady-state short-circuit current

I_{ac} i_{dc} $I_k(t)$ vary over time

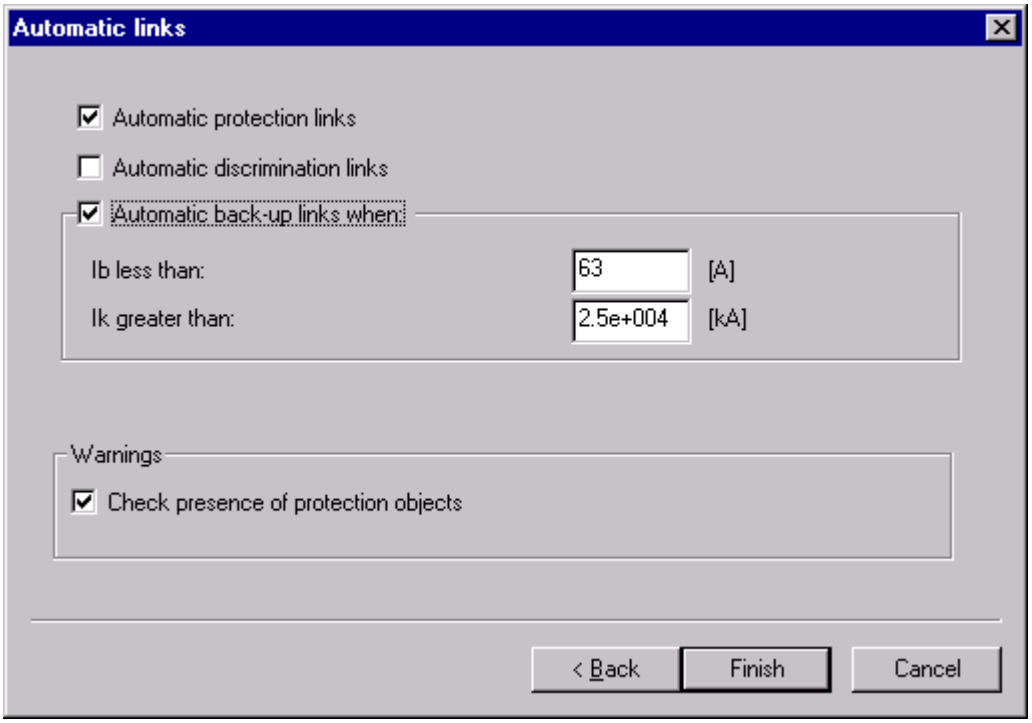
CALCULATION OF SHORT-CIRCUIT CURRENTS

Start calculation of short-circuit currents from:
- the '*TOOLS'* toolbar using the command 'Circuit analysis and dimensioning'
- the tools menu *Tools/Circuit analysis and dimensioning*

In the '*Control panel for short-circuit calculation'*, you can enter the following parameters:
- In the '*Method of calculation'* panel, determine the methodology used to calculate the short-circuit current;
- In the '*Fault' type* panel, select the fault type to be calculated*;*
- In the '*Other'* panel, you can decide whether to ignore the contribution of the motors, set type of overexcitation of generators and choose the temperature at which cable impedance is calculated for the calculation of minimum short-circuit currents;
- In the '*Currents at'* panel you can enter four times at which you want to calculate short-circuit currents.



Use 'Next' to choose whether to perform automatic dimensioning by specifying automatic connection between protection devices and devices to be protected, and discrimination or backup between the protection devices.



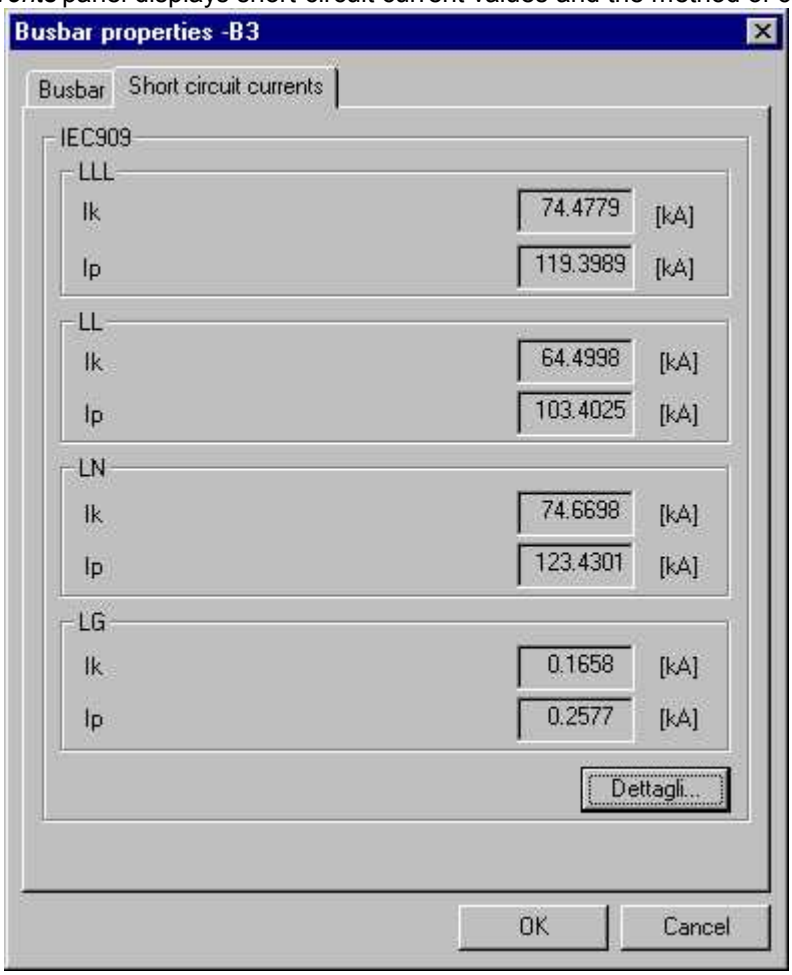
Press '*Finish'* to initiate calculation of the network and automatic dimensioning of objects present.

DISPLAY OF SHORT-CIRCUIT CURRENTS

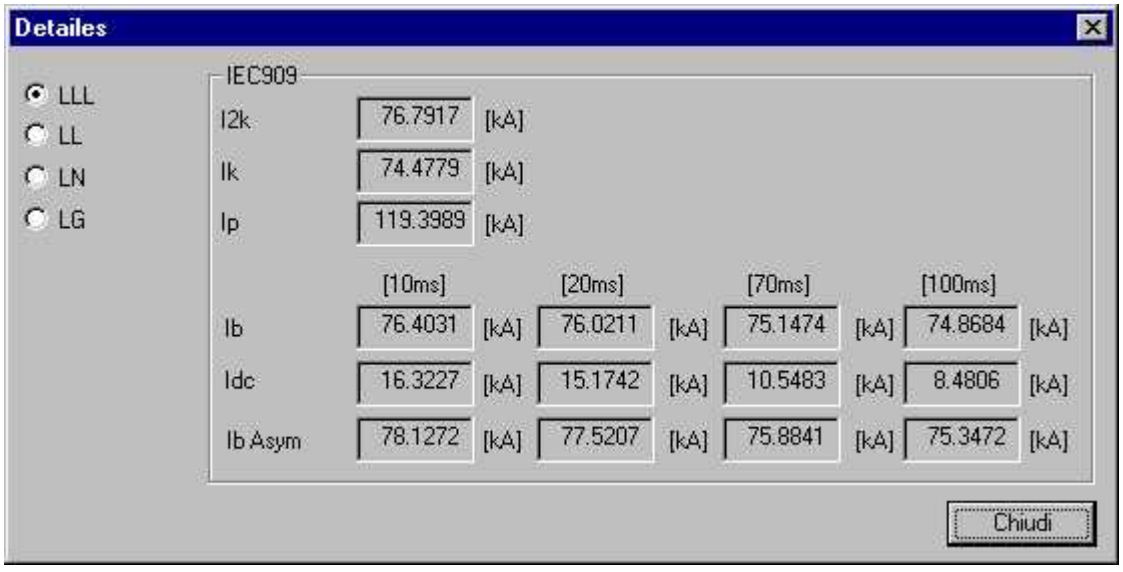
After you have initiated automatic network calculation, the short-circuit current values calculated are saved in the panels for individual objects.

Busbar

The '*Short circuit currents*'panel displays short-circuit current values and the method of calculation used.

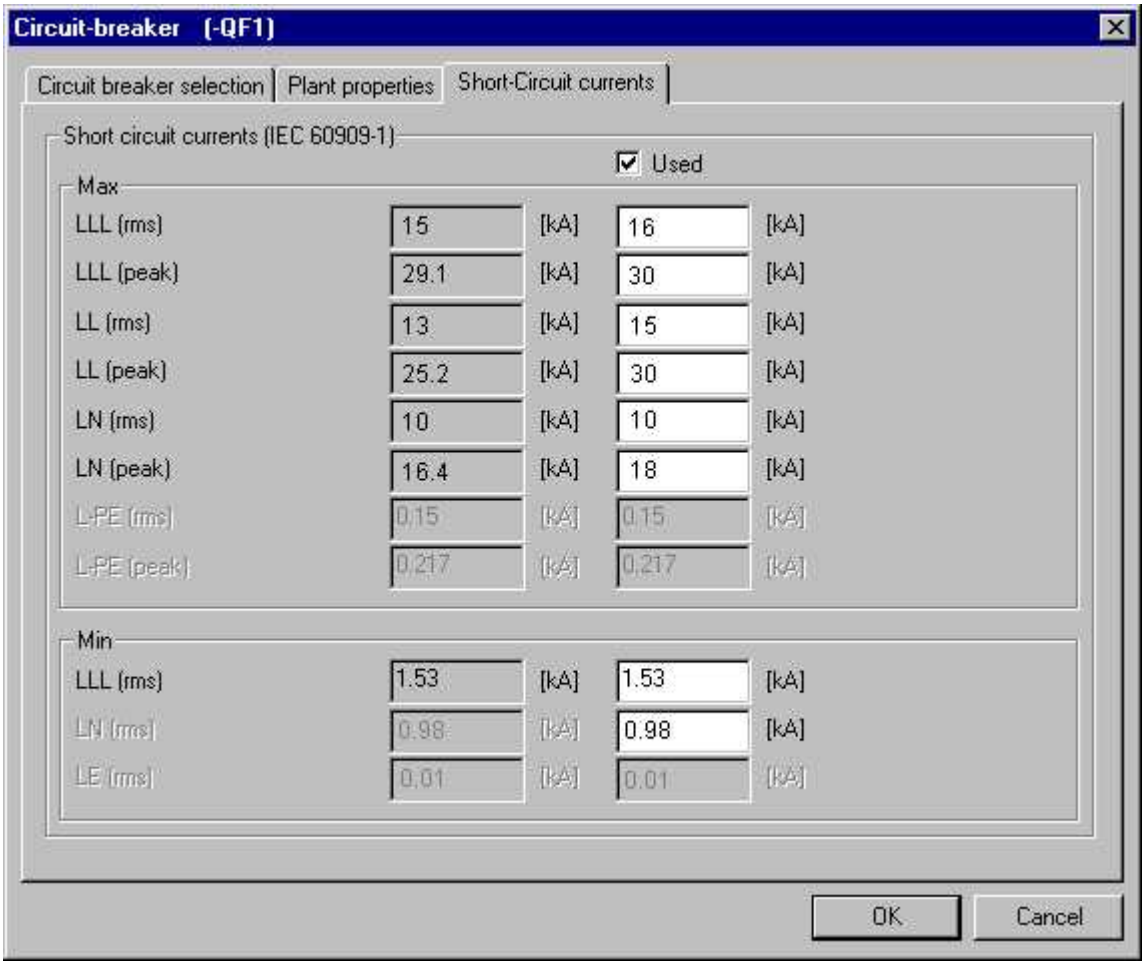


Press '*Details'* to display all other short-circuit current values requested by the calculation method chosen. These values represent maximum values.



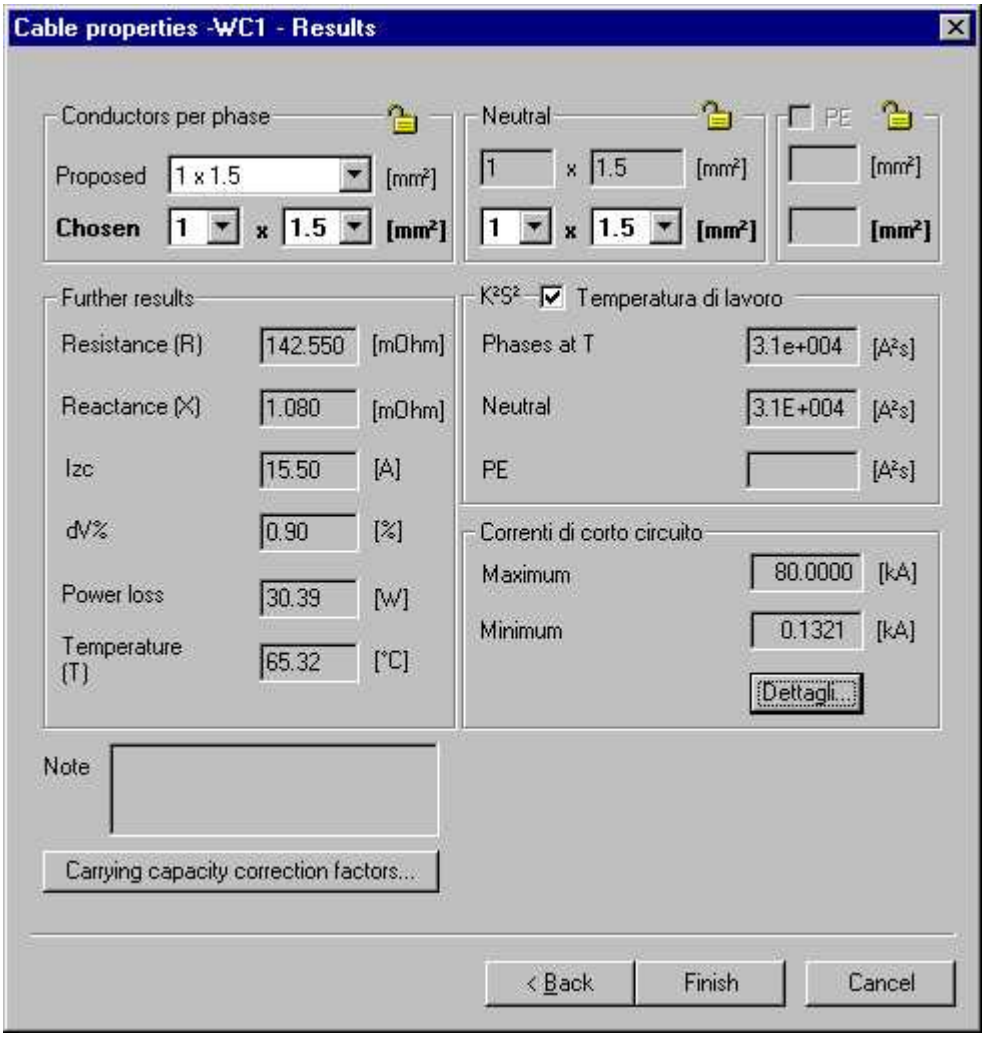
Circuit breaker

The '*Short circuit currents*' panel displays short-circuit current values and the method of calculation used. Maximum and minimum values are shown. The minimum value corresponds to the smallest short-circuit current flowing to an object protected by the circuit-breaker in question; for example, in the case of a line consisting of a circuit-breaker and a cable, the minimum short-circuit current is the minimum value calculated at the end of the line.

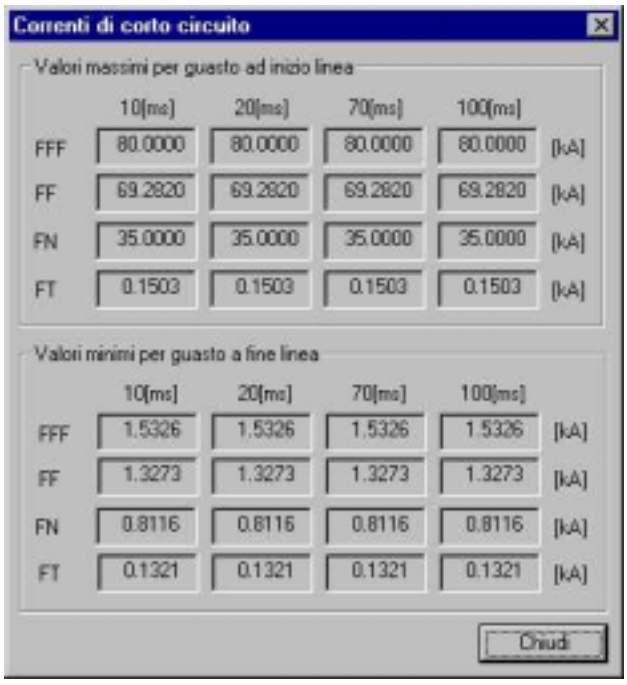

Circuit-breaker (-QF1)
Circuit breaker selection
Plant properties
Short-Circuit currents
Short circuit currents (IEC 60909-1)
Used
Max
LLL (rms) 15 [kA] 16 [kA]
LLL (peak) 29.1 [kA] 30 [kA]
LL (rms) 13 [kA] 15 [kA]
LL (peak) 25.2 [kA] 30 [kA]
LN (rms) 10 [kA] 10 [kA]
LN (peak) 16.4 [kA] 18 [kA]
L-PE (rms) 0.15 [kA] 0.15 [kA]
L-PE (peak) 0.217 [kA] 0.217 [kA]
Min
LLL (rms) 1.53 [kA] 1.53 [kA]
LN (rms) 0.98 [kA] 0.98 [kA]
LE (rms) 0.01 [kA] 0.01 [kA]
OK
Cancel

Cable

The 'Results' panel displays values for a maximum short-circuit current for a fault at the start of the line and for a minimum short-circuit current for a fault at the end of the line.

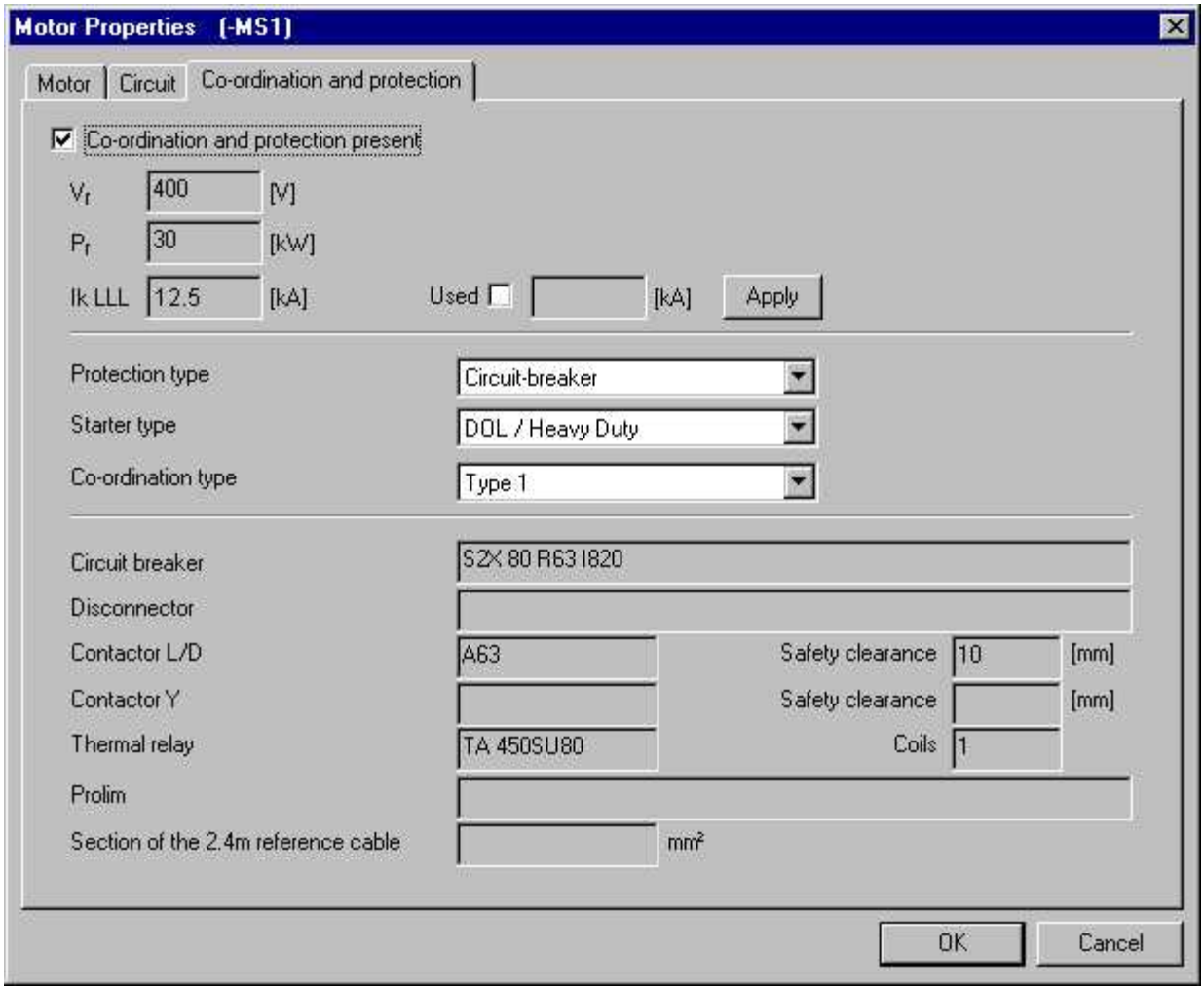


The '*Details*' button displays maximum values for short-circuit currents for a fault at the start of the line and minimum values for short-circuit currents for a fault at the end of the line calculated at the four timepoints set when automatic calculation was initiated.



Motor

The '*Co-ordination and protection*' panel displays the value of the maximum three-phase short-circuit current.



DRAWING CURVES

After you have dimensioned a network and chosen the components, the CURVE command allows you to draw the characteristic curves of the objects drawn.

Objects with a curve that can be shown are:
- Circuit breaker;
- Pure residual current relay;
- Fuse;
- Two windings transformer;
- Motor;
- Generator;
- Cable.

In particular, with DOCWin you can show the following curves:

-

Time-current (Three-phase);

-

Time-current (Phase-neutral);

-

Time-current (Phase-Earth);

-

Specific let-through energy (Three-phase);

-

Specific let-through energy (Phase-neutral);

-

Specific let-through energy (Phase-Earth);

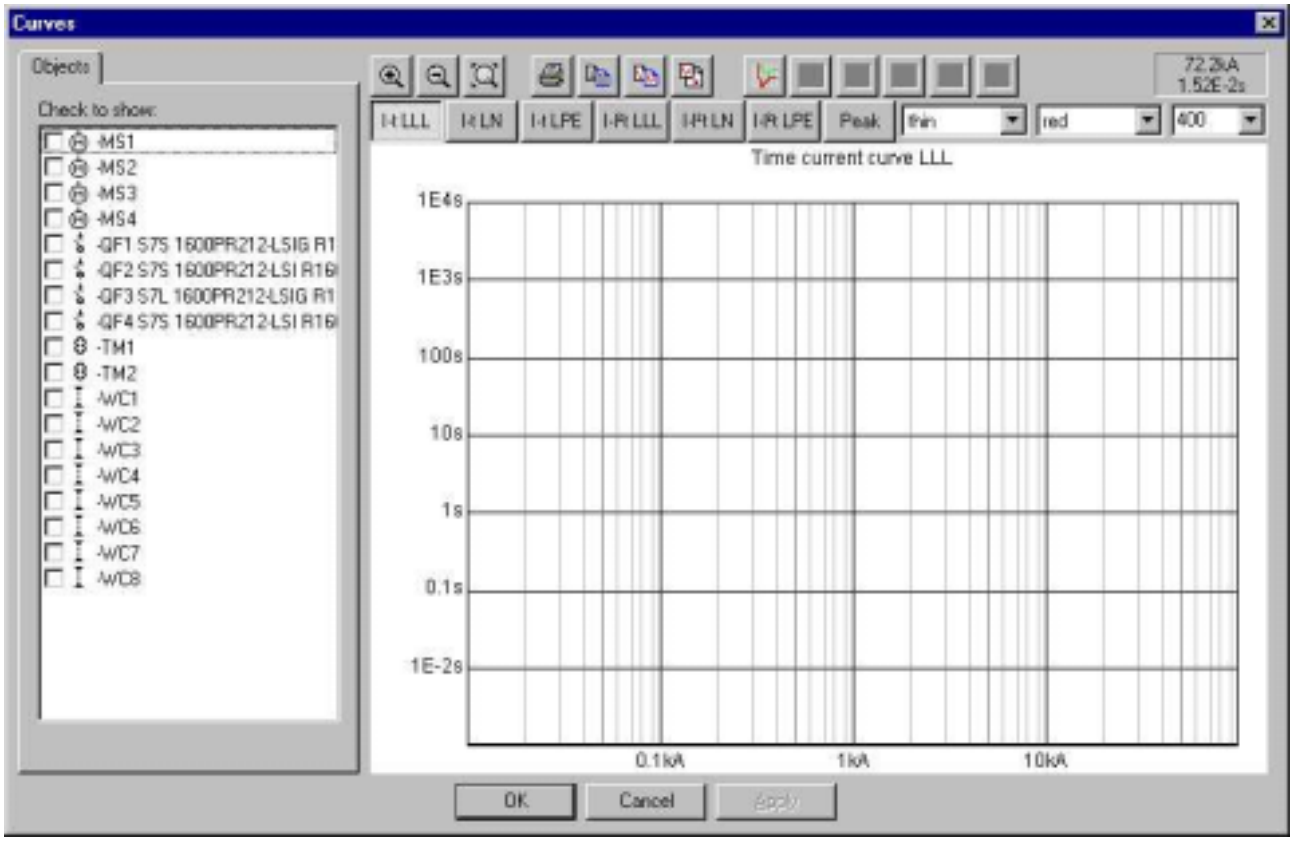
-

Limited current.

With reference to the figure below, you can choose the objects to be shown by selecting the box next to the name and type of property to display by pressing the appropriate button.

The toolbar commands apply to the chart you have selected.

Left-click on a curve to select it and make it current; curve-related toolbar commands then apply to that curve.



Commands applying to the current curve

DISPLAY OBJECTS: displays the curves for objects which are protected or which protect the current object

Id DISPLAY ID: allows you to add an identification label for the current object to a drawing

Ik DISPLAY ICC MAX: displays a vertical straight line which shows the maximum short-circuit current at the point of the network where the object is situated.

rosso CHANGE COLOUR: allows you to change the colour of the curve for the current object;

Sottile CHANGE WIDTH: allows you to change the width of the curve for the current object

400 CHANGE VOLTAGE: allows you to change the reference voltage for the chart and so to translate curves of objects which do not have the same reference voltage as the chart.

Commands applying to the current graph

ZOOM IN: allows you to enlarge the zone of the chart you are interested in, by identifying it with the mouse;

ZOOM OUT: allows you to enlarge the visible area of the chart by doubling it in size;

ZOOM EXTEND: extends the view to show the whole drawing;

PRINT: allows you to print the current chart;

COPY SETTINGS: copies the settings and properties of objects drawn in other applications;

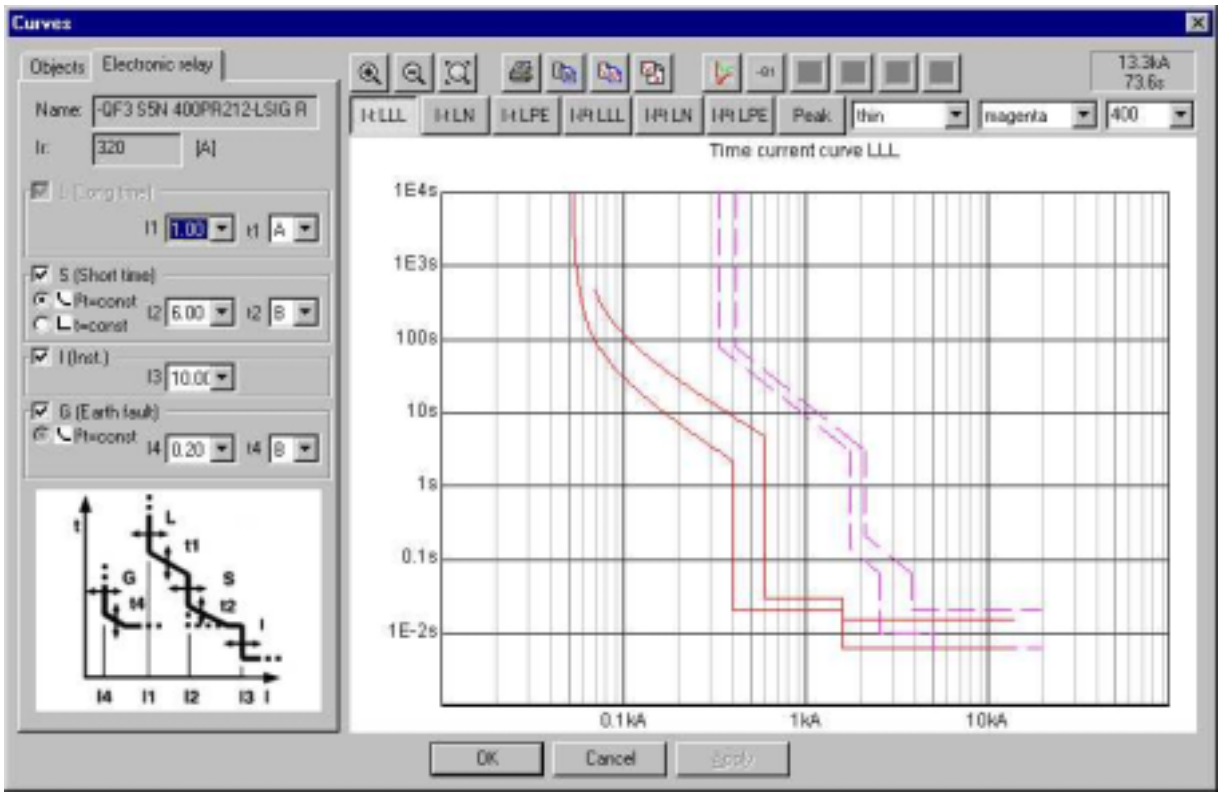
COPY: copies the current graph into other applications;

COPY TO ONE-LINE DIAGRAM: copies the current diagram and settings and properties of the objects shown onto a one-line diagram,;

When a curve has been selected, it is displayed with a broken line to show that it has become the current curve. In addition, the list of objects in the left part of the panel is moved to the back and is displayed in the control panel for the current curve.
The control panel displays parameters which you can use to obtain the correct setting for the current curve.

The figure below shows the curve for two circuit-breakers and a cable in a three-phase time-current chart.
Move the mouse over the chart to read the coordinates at top right.

When a magenta curve has been selected, you can edit the circuit-breaker relay settings as shown in the figure below.
You can also identify the curve with a name (as a default, DOCWin suggests the name of the object itself) and show the maximum short-circuit current that are affected by the circuit-breaker.



SWITCHBOARD THERMAL ANALISYS

TOOLS Menu: Switchboard thermal analisys

DOCWin allows the calculation of the temperature rise assessment by extrapolation for partially type tested assemblies (PTTA) of low voltage switchgear and controlgear.
In IEC 439-1 and CEI EN 60439-1 Standards, in the series of type tests, a temperature rise test is specified. However, for certain types of assemblies for which the performance of a temperature rise test is either not feasible or economically not justifiable a calculation of the temperature rise in the form of extrapolation from data found by tests on other assemblies may be made instead. Such assemblies are then called partially type-tested assemblies (PTTA). The factors and coefficients set out have been derived from measurements on numerous assemblies and the method has been verified by comparison with test results. The method described is therefore one possible method and may for partially type-tested assemblies be used to prove compliance with requirements of subclause 8.2.1 of IEC 439-1 and CEI EN 60439-1 Standards.
The following method is fully in compliance with 1IEC 890 and CEI 17-43 Standards and it is applicable to enclosed PTTA or partitioned sections of PTTA without forced ventilation.
The influence of the materials and wall thicknesses usually used for enclosures are negligible on the steady state temperatures.

Conditions of application
This method of calculation is only applicable if the following conditions are fullfilled:
- there is an approximately even distribution of power losses inside the enclosure;
- the installed equipment is so arramged that air circulation is but little impeded;
- the equipment installed is designed for direct current or alternating current up to and including 60Hz with the total of supply currents not exceeding 3150A
- conductors carrying high currents and structural parts are so arranged that eddy-current losses are negligible;
- for enclosures with ventilating openings, the cross-section of the air outlet openings is at least 1.1 times the cross-section of the air inlet openings
- there are no more than three horinzotal partitions in the PTTA or a section of it;
- where enclosures with external ventilating openings have compartments, the surface of the ventilating openings in each horizontal partition shall be at least 50% of the horizontal cross-section of the compartment.

Calculation procedure
For all types of enclosures specified in the Standard, the calculation of the temperature rise of the air is carried out, in cases according to IEC 890 and CEI 17-43 Standards, using the following procedure
1) Determination of the effective cooling surface Ae of the enclosure:
is the sum of the individual surfaces A_0 multiplied by the surface factor b. This factor takes into account the heat dissipation of the individual surfaces according to the type of installation of the enclosure (Table III).

$$A_e = \Sigma(A_0\ b)$$

2) Determination of the internal temperature rise of the air at mid-height of the enclosure:
the calculation is carried out according to the formula:

$$T_{0.5} = k\ d\ Pd^x$$

where:
k = enclosure constant (fig.3, fig.5, fig.7)
d = temperature-rise factor for internal horizontal partitions inside enclosure (table IV , Table V)
Pd = effective power loss of the equipment installed inside enclosure
x = exponent (Table I)

3) Determination of the internal temperature rise of the air at the top of the enclosure:
the calculation is carried out according to the formula:

$$T_{1.0} = c\ T_{0.5}$$

where:
c = temperature distribution factor. It determination varies with the design and installation of the assembly as follows
a) A_e > 1,25 m² without ventilation openings
c is depending from Figure 4 where f is defined as follows:

f= h^(1.35)/Ab

where:
h = enclosure height [m]
Ab = enclosure base surface [m²]

b) A_e > 1,25 m² with ventilation openings
c is depending from Figure 6 where f is defined as befor.

c) $A_e \leq$ 1,25 m² without ventilation openings
c is depending from Figure 8 where g is defined as follows:

g= h/w

where:
h = enclosure height [m]
w = enclosure width [m]

Calculation methods according to IEC 439-1 and CEI EN 60439-1 Standard are based on the principle for which each enclosure releases (through radiation and convection) a certain quantity of energy through its surface (referred to the time unit). Then the power loss (Pd) will be given by the sum of two components:

Pd = Pp + Pv

where:
Pv: power loss to be removed by the ventilator in order to keep the temperature-rise value inside the enclosure within acceptable limits.
Pp: power radiation through the effective cooling surface of the enclosure

All that allows for determination of the max. power that can be applied inside the enclosure

By the following formula the temperature rise of the air at the top of the enclosure is obtained:

T10=tm-ta

where:
tm = max. temperature rise of the air inside the PTTA
ta = ambient temperature of the air around the PTTA

By the following formula the dissipated power through forced ventilation is obtained:

Pv=(T10 * Q)/3.125

where:
Q = ventilator air capacity expressed in m^3/s

By the following formula the power radiation through the effective cooling surface of the enclosure is obtained:

Pp=(T10/(c*k*d))^(1/x)

By the following formula the power values that can be applied inside the PTTA is obtained:

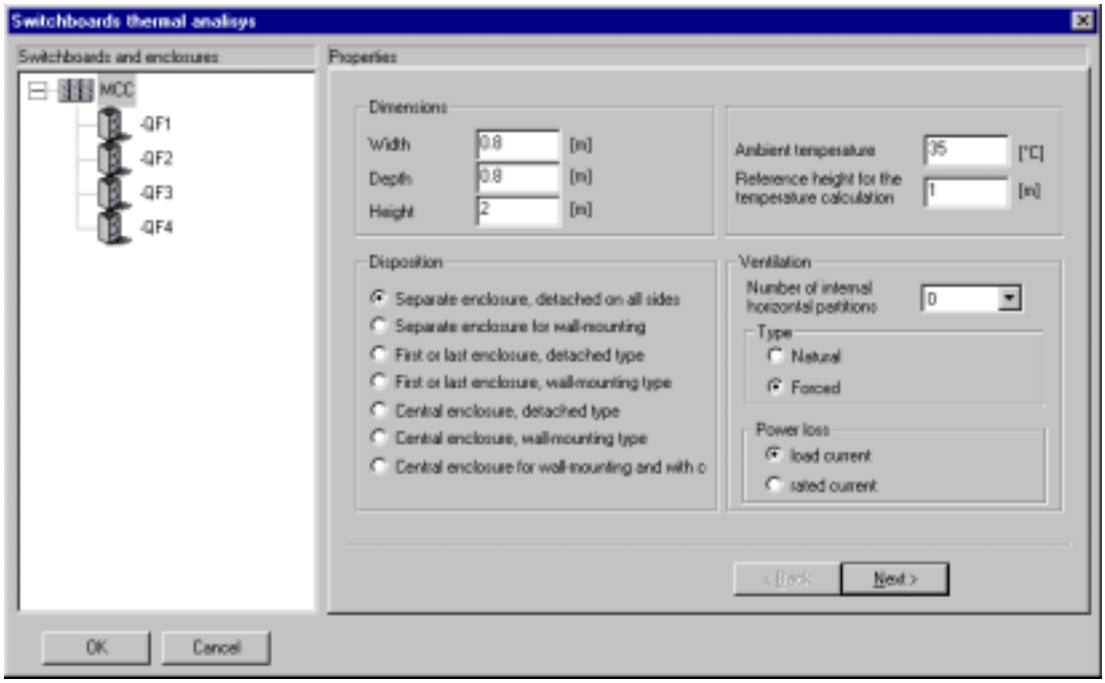
Pd = Pp+Pv

According to IEC 439-1 and CEI EN 60439-1 Standards the temperature rise of the air inside the PTTA should be compatible with the service conditions of the single components. For example, PVC insulated cables having service temperature of 70°C should not be installed in environments with a temperature exceeding 60°C. All that is valid also for the protection devices. The max. service temperature at which the ABB SACE circuit-breakers should be installed is 55-60°C. Therefore, the temperature rise of the air inside the PTTA should not exceed 60°C

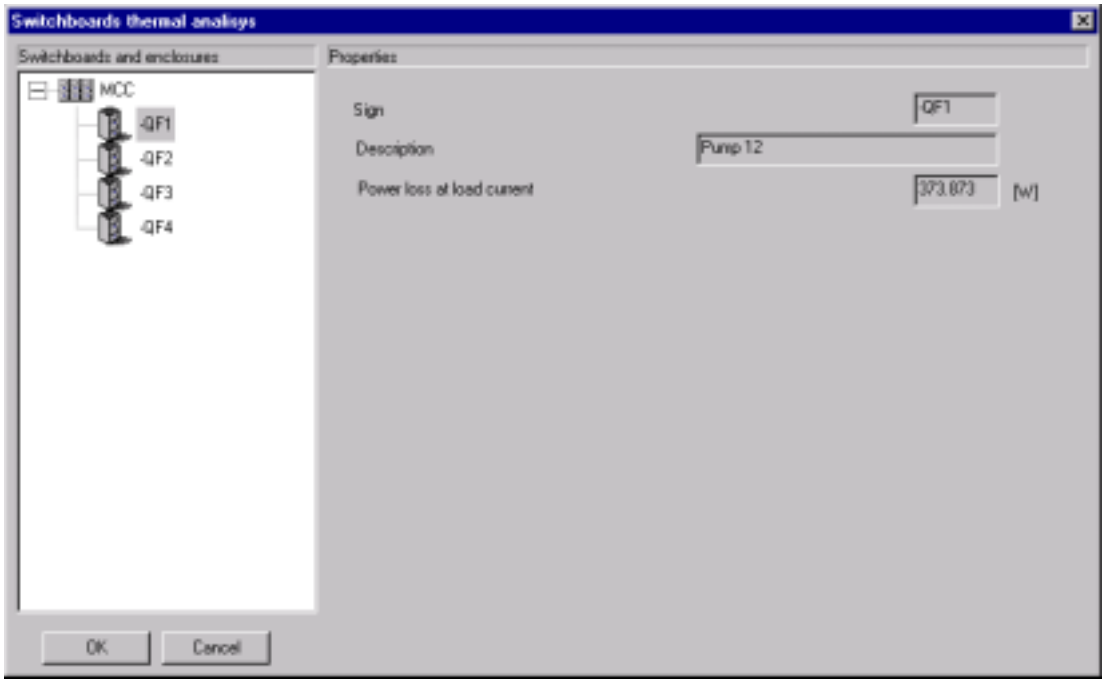
Unless otherwise specified, the ambient air temperature outside the PTTA is the air temperature indicated for indoor installation of the PTTA (average value over 24 h) of 35°C. If the ambient air temperature outside the PTTA at the place of use exceeds 35°C, this higher temperature is deemed to be the ambient air temperature of the PTTA.

Switchboard thermal analisys

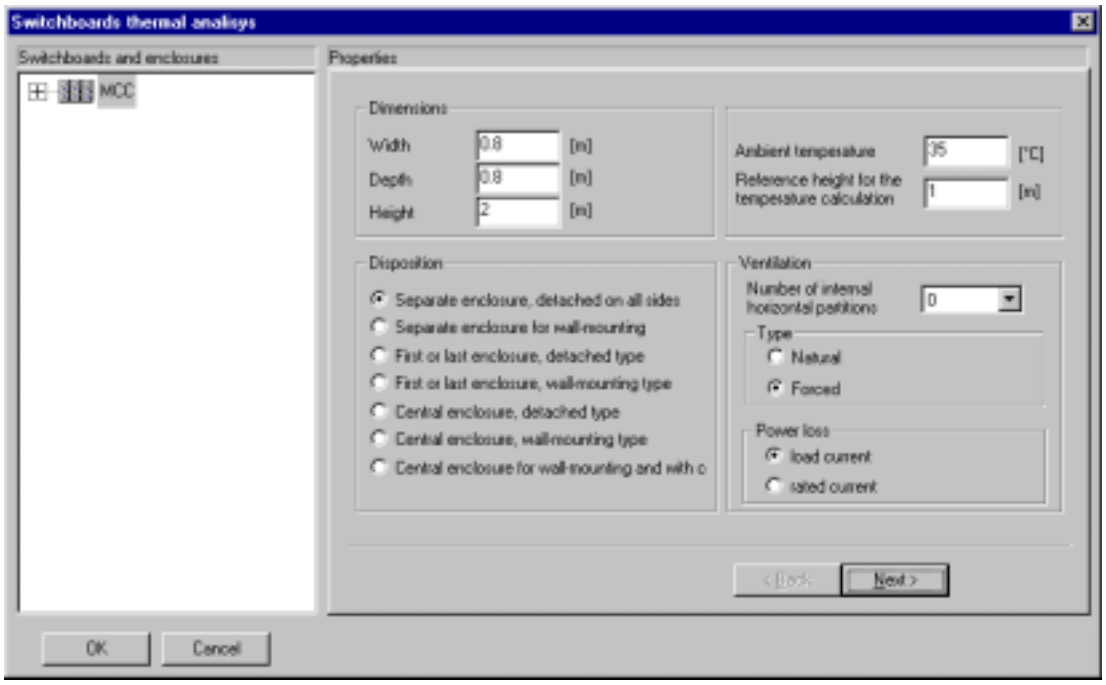
The panel '*Switchboard thermal analisys'* shows the enclosures of the project. Choose an enclosure to show the list of the equipment.



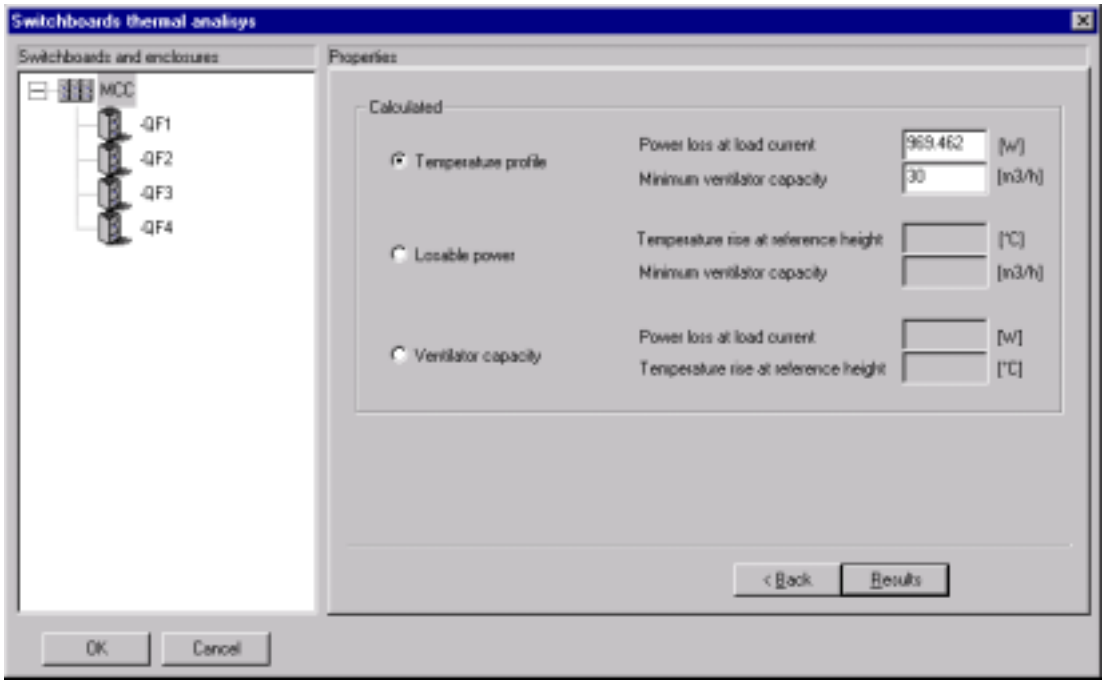
Choosing an equipment, the sign, the description and the power loss will appear on the right part of the window.



Choose 'Next' to open the window 'P*roperties*' and input the enclosure data.



Click on '*Next*' to choose the calculation method.



Finally, click on '*Results*' to show the results.

PRINTING

PRINT PROJECT

DOCWin allows you to print the drawing on any system printer or plotter installed under Windows. DOCWin has a 'Printer setup' command for this purpose, which opens the Windows dialogue box to configure the printer specifications, and a 'Print' command, which allows you to manage various print parameters for hard copy (reference to drawing sheet, scale, sheet margins, colour-width translation).

FILE menu: Print setup...

To set print parameters
The command opens the Windows dialogue box which allows you to perform the operations of selecting the current printer or plotter, to specify type of paper source for the printer, title block, print orientation (landscape or portrait), print resolution and advanced print options relating to the current printer.
The appearance of the dialogue box and the structure of the related commands are based on the printers preset in Windows.
Print margins can also be set from within the 'Print' command.

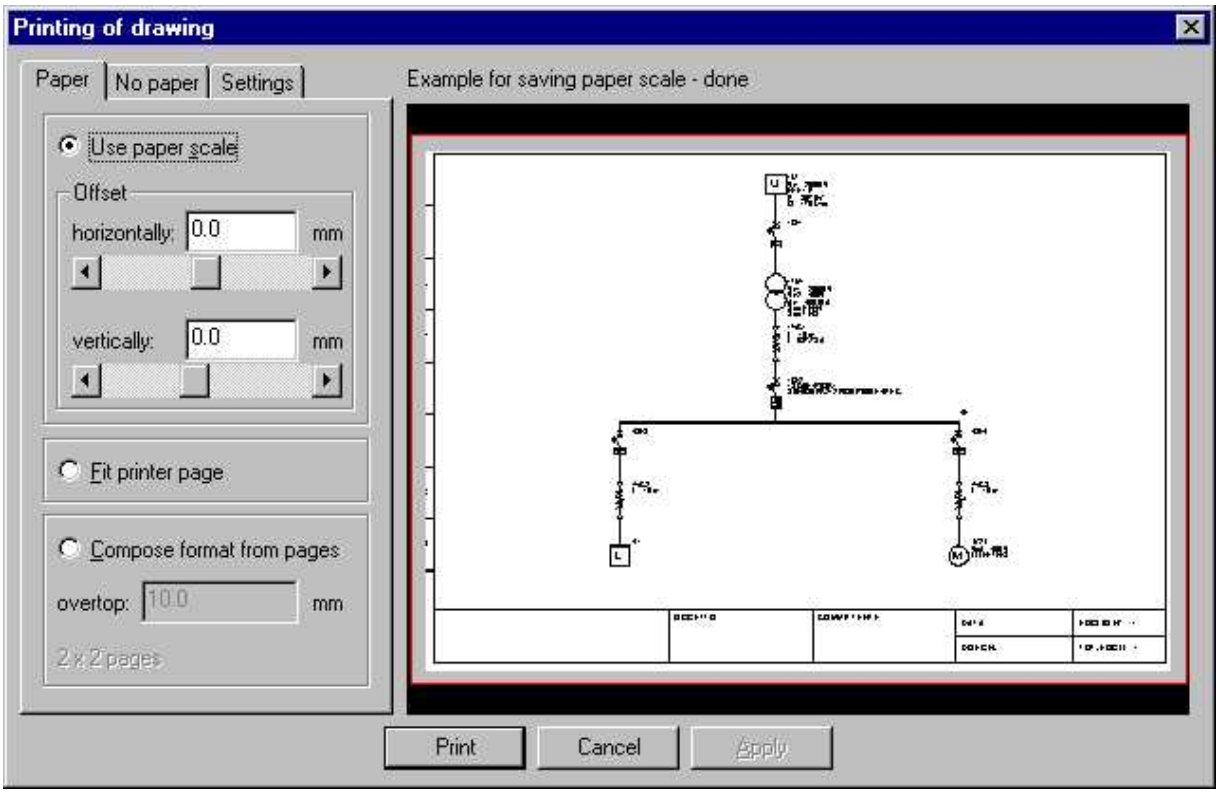
FILE menu: Print
Function keyCTRL+P

The Print command brings up dialogue box divided into three sections:

Page	allows you to print a drawing made on one drawing sheet, retaining the settings and using a print preview window to compare them with printer settings.
No page	allows you to print without taking the drawing sheet into consideration and to check display settings through a print preview dialogue box.
Settings	allows you to set print margins and colour-width conversion of the entity.

Page section
The print preview window shows the overall dimensions of the drawing sheet (shown with a red line) and the paper (shown in white) inside the margins (grey).
At this point, you can print the project:

- using the scale of the drawing sheet and moving the origin of the drawing from the edge of the paper (*Scaling* horizontal and vertical);
- by adjusting the drawing sheet dimensions to those of the paper (taking print margins into account as well - see Settings section);
- by dividing the result onto several sheets of paper. This option is useful when you want to print a large drawing and have a smaller format printer. The *Superimposition* box displays the number of millimetres of paper which must be superimposed when you reassemble the four printed sheets.



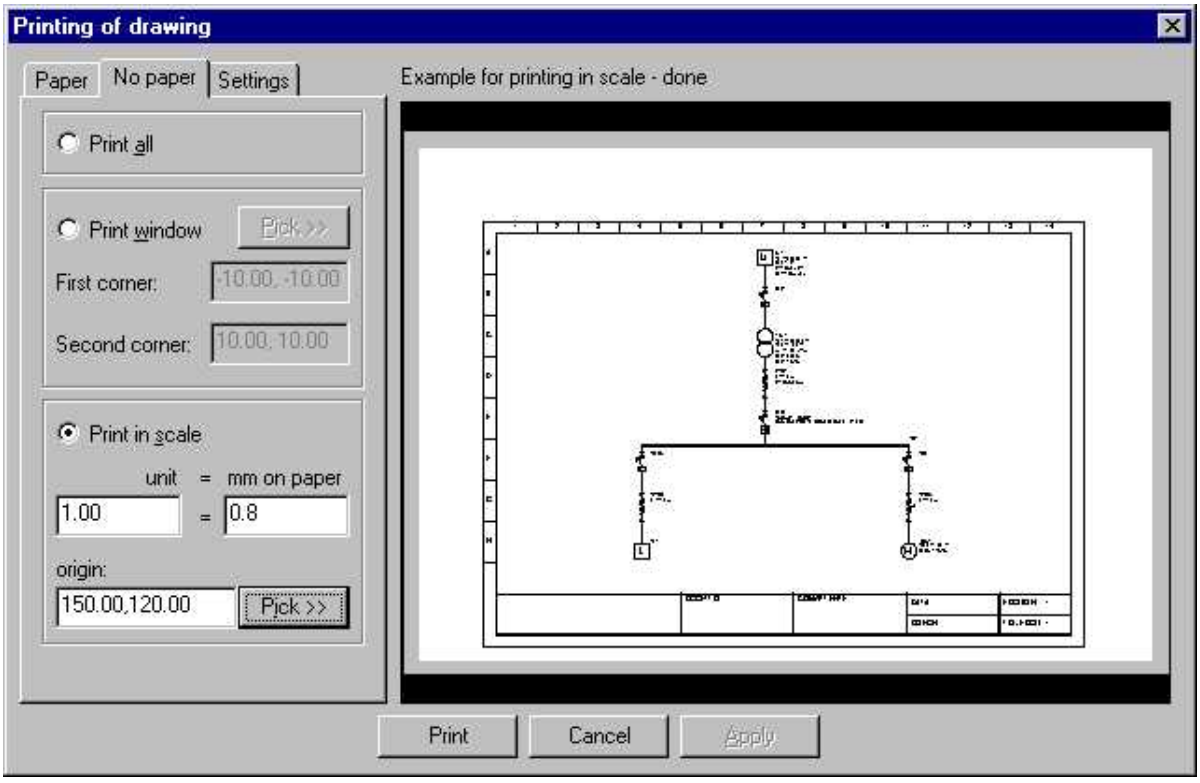
No Paper section

As mentioned earlier, this section is used when you want to print the drawing without taking account of the dimensions of paper set using the PAGE SETUP command.

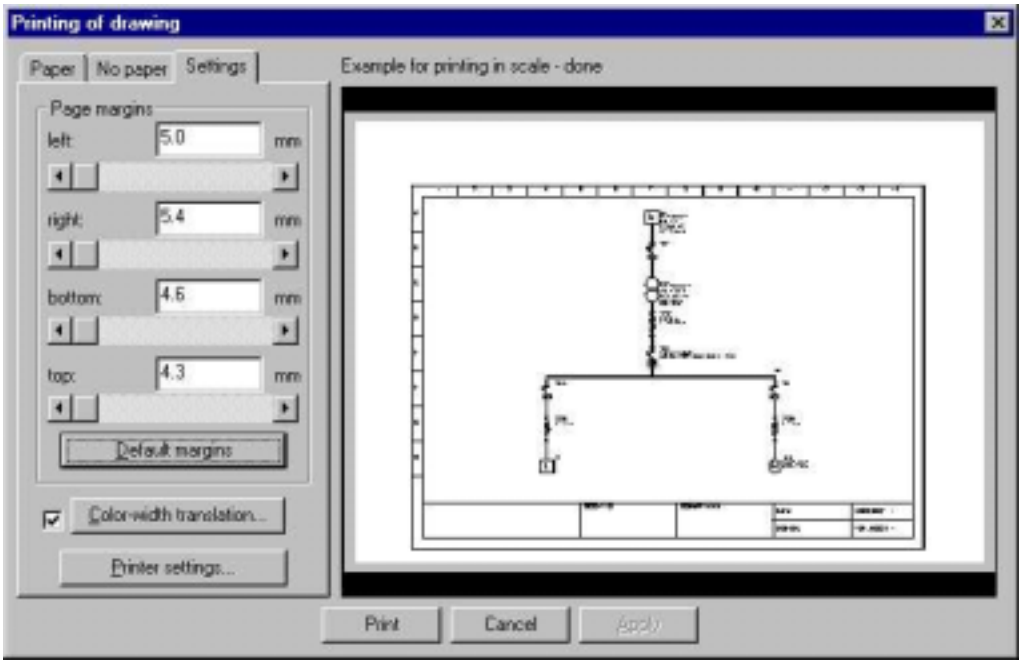
Select '*Print all*' when you want to print your own drawing to the maximum size available on the printer.

If you select '*Print window*' you can show (*Pick* button) a window on the drawing which will be printed at the maximum paper size.

By using '*Print in scale*' you can set a ratio between the unit used for the drawing and millimetres as printed. The print origin is also shown in the same section.



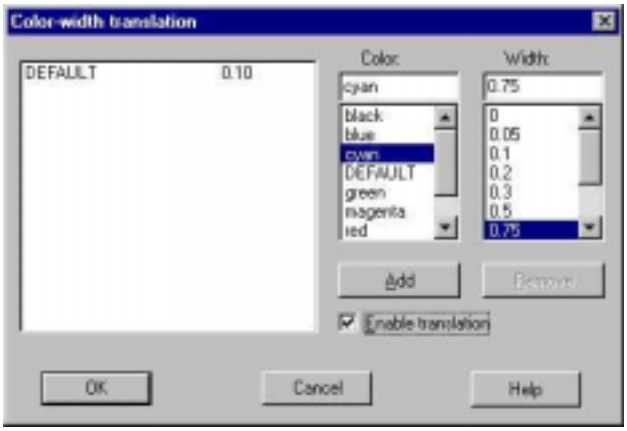
Settings Section



This section displays other essential print parameters:

- Preset print margins.
  You can modify individual print margins and see the result in the print preview window, or automatically restore the default margins of the peripheral device by clicking on the '*Default margins'* button
- Colour-width translation.
  The colour in which each entity is shown on the display can be converted at the printing stage into a width of black. Settings will be retained permanently until they are modified again.
  To add a colour to the translation list:
  1. select the colour to be translated from the list under the heading *Colour*.
  2. select the width in millimetres to be assigned on hard copy to entities of the colour selected using the list '*Width'*; alternatively you can type a value for width.
  3. press *Add*.

  To remove a colour from the translation list, select the combination and press *Remove*.
  To enable or disable translation, select or deselect the box *Enable translation*.



- Print settings, which is displayed by the command 'Print setup' (see previous paragraph) to modify advanced parameters for the preset peripheral device.

To print a drawing

- Start the print command.
- Define in detail the type of printing you want.

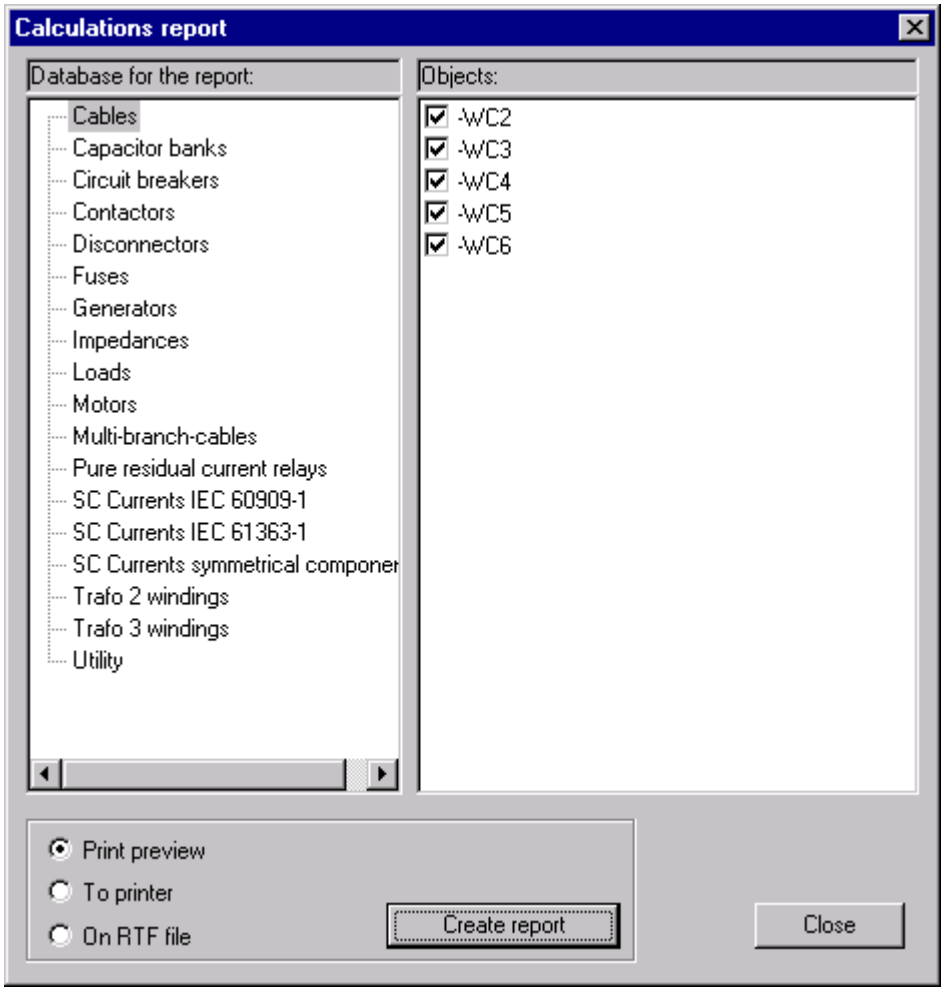
Confirm the settings by clicking on '*Print'*.

PRINT REPORT

FILE menu: Print report

DOCWin allows you to print calculation reports for a project.
Select the report database you want and select the display mode from:

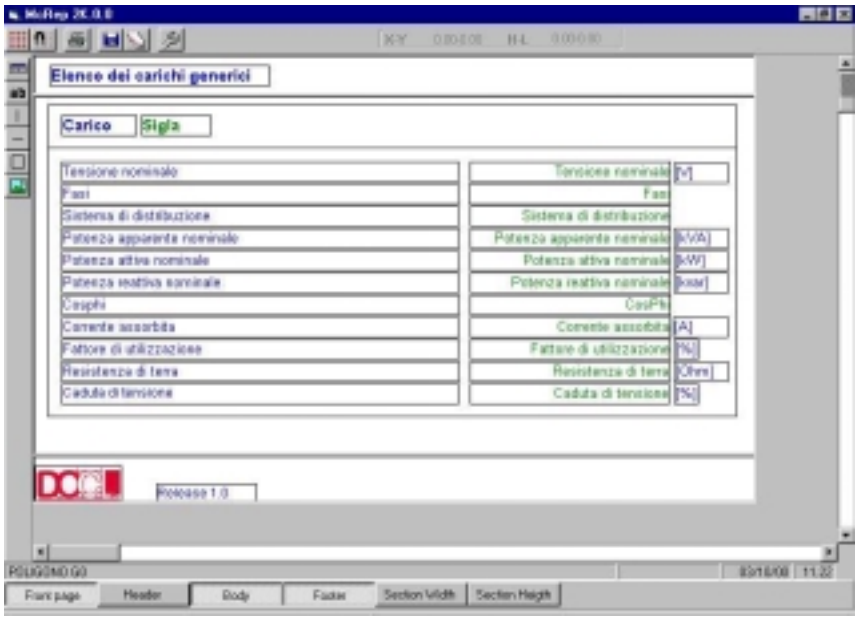
- Print preview: preview the report on the monitor.
- Print: make a hard-copy printout of data.
- RTF file: creates a text file in Rich Text Format (compatible with a very wide range of word processors)



MODIFYING REPORT PRINTING

FILE menu: Edit report

The '*Edit report*' *command allows you*' to modify report printing, which you can use to customize the settings of the template as you wish, by inserting *Fields, Free text, Lines and Logos.*



INSERTING AND CUSTOMIZING OBJECTS

To insert a new field

- Click at the point where you want to insert the new field.
- Select the '*New field*' command.
- A list of fields that can be inserted is displayed.

- Select the desired field and confirm by pressing '*Select*'.

To change the size of a field

- Position the cursor on one of the sides of the field until the cursor changes shape and becomes: ↔ or ↕ .
- Move in the direction in which you want to modify the field, holding the left mouse button down, and release it only when your have reached the size you want

To move a field within a print template

- Position the cursor on the field until the cursor changes shape and becomes: ✥ .
- Drag the field while holding the left mouse button down, and release it when it is positioned in the right place on the page.

To insert a new free text item

- Click at the point where you want to insert the new free text.
- Select the '*New free text*' command.
- A window containing the text to be inserted is displayed.
-

- Confirm with *OK*.

Example of a title

To change the size of free text

- Position the cursor on one of the sides of the field until the cursor changes shape and becomes: ↔ or ↕ .
- Move in the direction in which you want to modify the field, holding the left mouse button down, and release it only when your have reached the size you want.

To move text within a print template

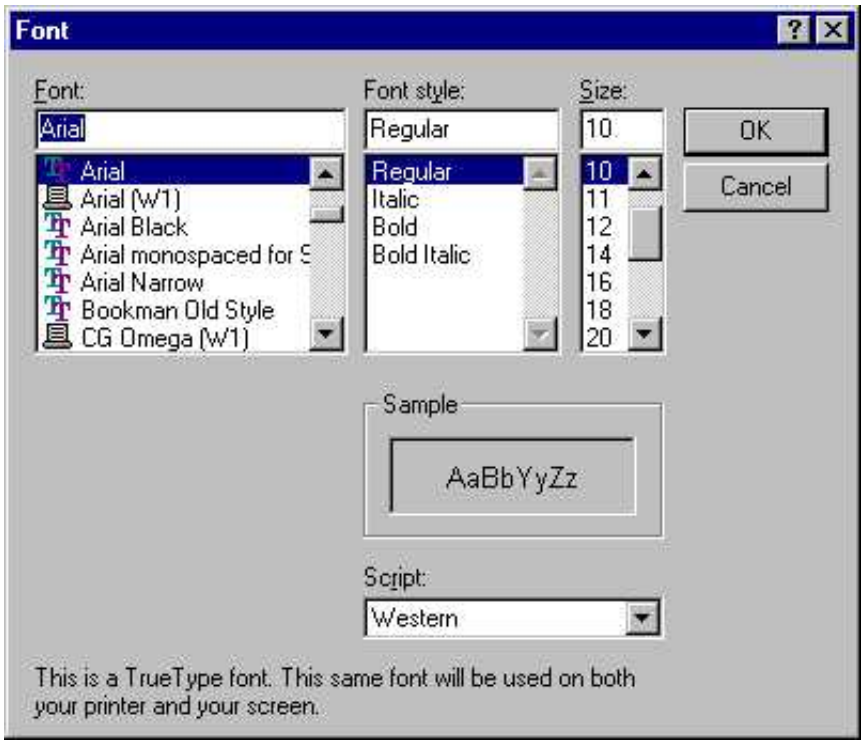
- Position the cursor on the field until the cursor changes shape and becomes: ✥ .
- Drag the free text while holding the left mouse button down and release it only when it is positioned in the right place on the page.

To change text alignment

- Select a field or free text.
- Click on the left alignment button.
- Click on the centre alignment button.
- Click on the right alignment button.

To modify the font of a field or free text

- Select the field or text in the font you want to change.
- Click on the command '*Change font of selected element*'
- The following window appears:



- Define Font, Style and type size (font height is defined by point size).
- Confirm with '*OK*'.

To insert a vertical line

- Click on the point where you want to insert the line.
- Select the command '*New vertical line*'

To insert a horizontal line

- Click on the point where you want to insert the line.
- Select the command '*New horizontal line*'
-

To change the size of a line

- Position the cursor on one end until the cursor changes shape and becomes: ↔ or ↕ .
- Move in the direction in which you want to modify the line, holding the left mouse button down, and release it only when your have reached the size you want.

To move a line within a print template

- Position the cursor on the line until the cursor changes shape and becomes: ✥ .
- Drag the field while holding the left mouse button down, and release it only when it is positioned in the right place on the page.

To insert a rectangle

- Click on the point where you want to insert the rectangle.
- Select the command '*New rectangle*'

A rectangle like this is inserted:

To change the size of a rectangle

- Position the cursor on the rectangle until the cursor changes shape and becomes: ↔ or ↕ .

- Move in the direction in which you want to modify the rectangle, holding the left mouse button down, and release it only when your have reached the size you want.

To move a rectangle within a print template

- Position the cursor on the rectangle until the cursor changes shape and becomes: ✣ .
- Drag the field while holding the left mouse button down, and release it only when it is positioned in the right place on the page.

To insert an image or logo

- Click on the point where you want to insert the image.
- Select the command '*New image*'. A window is displayed:

- Select an image file.

An image is inserted with the file path for the image.

To change the size of an image

- Position the cursor on one side of the image until the cursor changes shape and becomes: ↔ or ↕ .
- Move in the direction in which you want to modify the size of the image, holding the left mouse button down, and release it only when your have reached the size you want.

To move an image within a print template

- Position the cursor on the image until the cursor changes shape and becomes: ✣ .
- Drag the field while holding the left mouse button down and release it only when it is positioned in the right place on the page..

To move a number of objects, hold down the SHIFT key on the keyboard while selecting them; once all objects to be moved have been selected, drag the mouse while holding down the left button and keeping the keyboard SHIFT key held down. Release the buttons when the move has been completed.

To delete an object

- Select the object you want to delete.
- Click on '*Delete*'.

ALIGNMENT AND TOOLS

To position and align objects

The reference grid is a network of points at equal distances from each other and is used to help you position objects on the page you are creating.

• To enable the '*Grid*' command, click on the icon in the toolbar.

The '*Snap*' function allows you to move objects only on points of the grid, improving alignment.

• To enable the '*Snap*'SNAP command, click on the icon in the toolbar.

Print preview

To display print and check that the changes made are what you wanted, use 'Print preview' command.

Before displaying print preview, you have to save the print template you have just modified.

PAGE SECTION

The work sheet consists of a number of sections:

Front page	is printed once, at the start of printing;
Header	is printed at the top of each page;
Body	contains data to be printed if there are multiple rows (for example, the body of an invoice or a transport document);
Footer	is printed at the bottom of each page.

Each section can be a different height and width.

Section Width	allows you to modify print width. When the button is enabled, a new width will be requested, in centimetres. Enter a number between 0 and 50.
Section Heigth	allows you to modify the height of the current section. When the button is enabled, the new height of the section will be requested, in centimetres. Enter a number between 0 and 50.

Remember that the total height and width of the various sections cannot exceed the actual print dimensions of the paper used (e.g.: A4 = 210 x 297 mm).

SAVE / RESTORE PRINT

SAVE

If you want to use the template just created for future printing, you should save modifications using the '*Save changes*' command.

SAVE AS ...

If you want to use the template just created for future printing, without overwriting the original template, you should save the modifications made using the command '*Save changes as*'.

To restore the original print templates

If the modifications made are not satisfactory, you can restore the original settings directly from the CD used for installation.
Insert the DOCWin installation CD-ROM and click on 'Restore current printer from CD-ROM'.

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